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FROM WEST TO EAST: LOWER AND MIDDLE PALAEOLITHIC BONE RETOUCHERS IN NORTHERN FRANCE

Abstract

At the end of the Lower Palaeolithic and into the Middle Palaeolithic, Neanderthals inhabited northern France, and many archaeological sites preserve accumulations of various lithic industries, sometimes associated with bones. From a few sites, the faunal remains show traditional marks of anthropic activities linked with butchery, including skinning, dismembering, meat filleting and marrow extraction. Some bones also present surface modifications characteristic of utilisation as tools; these are called retouchers or *retouchoirs*. The oldest site, the Acheulean occupation at Cagny-l'Épinette (Somme), yielded only six retouchers. In comparison, the main collection of the Middle Palaeolithic site of Biache-Saint-Vaast (Pas-de-Calais) contained 333 of these objects. Here, we also present new data on the retouchers from two more recent Middle Palaeolithic sites: Le Rozel (Manche) and Mutzig (Bas-Rhin). A regional synthesis of previously published and unpublished archaeological materials allows for new insights into the functionality of bone retouchers from northern France. This study suggests a relative homogeneity and standardization in Neanderthal behaviour and bone tool utilization for tens of thousands of years, with some differences from site to site. Most retouchers were made from herbivore limb bone diaphyses, but also on brown bear at Biache-Saint-Vaast. At le Rozel, a red deer mandible was used as retoucher. The pattern of utilization of the bones is variable, ranging from only a few clustered scores to a huge loss of cortical bone material linked to intense activity, and sometimes with up to four use areas on the same bone. In this study, we explore the many factors that may account for these differences.

Keywords

Neanderthals; Lower Palaeolithic; Middle Palaeolithic; Retouchers; Northern France

Introduction

During recent decades, many archaeological sites with Middle Palaeolithic occupations have been discovered in northern France. Some of these sites are important for understanding the lifeways of fossil hominids, especially for Neanderthal (and pre-Neanderthal) subsistence behaviour, territorial mobility and land use strategies. In some cases, faunal remains are found associated with lithic industries,

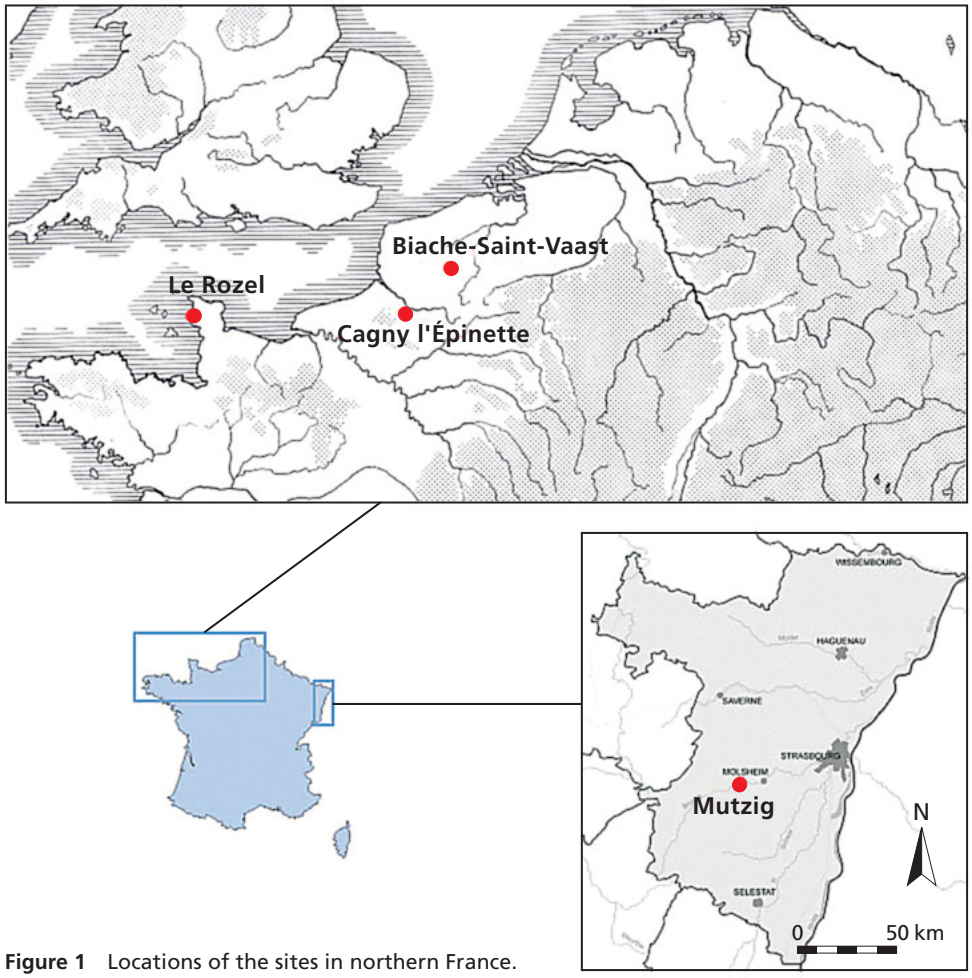

Figure 1 Locations of the sites in northern France.

providing evidence for hunting and butchery activities in the form of cut marks, scraping marks, helical fractures and bones used as retouchers.

Mentioned for the first time in 1883 (Daleau, 1884), retouchers were officially defined by G. and A. de Mortillet (1900) in their publication on prehistory. A few years later, L. Henry-Martin (1906, 1907, 1907-1910) discovered and studied retouchers from La Quina, then started discussions about their functionality. After that, discoveries of retouchers greatly expanded, mainly in French sites. More recently, a number of referential works about retouchers were compiled and published by the *Commission de nomenclature sur l'industrie de l'os préhistorique* (Patou-Mathis, 2002). A complete study of the 333 retouchers from Biache-Saint-Vaast was described in that volume (Auguste, 2002). Subsequently, new discoveries were made and new technological approaches were developed, including advances in experimental archaeology (e.g., Jéquier et al., 2012; Mallye et al., 2012; Daujeard et al., 2014). New data from Cagny-l'Épinette show that these bone tools were present in northern France since at least the end of Lower Palaeolithic (Moigne et al., 2016).

For the present study, the bone retouchers from four archaeological sites located in northern France are described (**Figure 1**): Cagny-l'Épinette (Somme), Biache-Saint-Vaast (Pas-de-Calais), Le Rozel (Manche), and Mutzig (Bas-Rhin). All the sites preserve hominin occupations dating to the Lower and Middle Palaeolithic (**Figure 2**). The aim of this paper is to offer a new interpretation for the historic retoucher series from Cagny-l'Épinette and Biache-Saint-Vaast and to present the two unpublished retoucher series from Le Rozel and Mutzig.

Material and methods

Taphonomic and zooarchaeological studies have been published for Cagny-l'Épinette and Biache-Saint-Vaast, and are in progress for Le Rozel and Mutzig. The study of these retouchers is part of a broader zooarchaeological research programme covering northern France. We examined the type of bone blanks used as retouchers (species, skeletal element, bone portion), the active use areas (number, shape, pits and scores, location on the bone) and other associated anthropic marks. Finally, the retouchers were analysed with respect to their specific archaeological contexts.

The observation of retouchers was first made macroscopically, then with a stereomicroscope when necessary. Photographs were made of each retoucher, using the stereomicroscope and software CombinZM at the University of Lille or the microscope from the University of Basel.

For the study of these retouchers, we used the definitions and vocabulary established in 2002 by the *Commission de nomenclature sur l'industrie de l'os préhistorique* (Patou-Mathis, 2002). Experimental replication by Mallye et al. (2012) served as a reference for understanding the possible gestures involved in the use of these retouchers.

MIS	Date	Stratigraphy	Biozone	Cultural contest	Northern France sites
2				Final Palaeo. Upper Palaeo.	Conty / Dourges
3	60 ky				Hénin-sur-Cojeul Beauvais / Ault
4		Weichselian	26		
5a à 5d	110 ky			Middle	Bettencourt-Saint-Ouen Mont-Dol Mutzig Le Rozel
5e	130 ky	Eemian	25	Palaeolithic	Caours
6	190 ky	Saalian	24		Gentelles / Arques / La Cotte de St-Brelade Piégu / Tourville D / Montières / Moru / Sempigny Biache-Saint-Vaast / Ranville
7	240 ky				
8	300 ky				Argoeuves
9			23		Cagny-l'Épinette / Cléon
10	400 ky		22		
11		Holsteinian			Cagny-la-Garenne II / La Celle Cagny-la-Garenne I
12	500 ky	Elsterian		Lower	
13 à 22	900 ky	Cromerian	21	Palaeolithic	Abbeville (Carpentier / Léon) Wissant Grâce
23 à 31	1,1 M	Bavelian	20		Saint-Prest

Figure 2 Chronostratigraphic and cultural positions of the sites (after Auguste, 2009).

Results

Cagny-l'Épinette

The open-air site of Cagny-l'Épinette is located in the Somme Valley, in a terrace of the Avre River near the city of Amiens (Tuffreau et al., 1986, 1995, 1997). Locally, ten different alluvial sheets have been recognized (Antoine, 1994); number IV is the l'Epinette system. Each alluvial sheet represents an interglacial/glacial cycle, the oldest of which is the Grâce alluvial sheet with an age older than the Bruhnes-Matuyama paleaomagnetic boundary (781 ka). This position is supported by the palaeontology (Auguste, 1995a), silty cover, ESR, U/Th and magneto-stratigraphy (Bates, 1993; Laurent et al., 1994).

The fluvial deposits at l'Epinette, were dated by ESR to 296 ± 53 ka (Laurent et al., 1994), which is in agreement with the characteristics of the large mammal assemblage (Tuffreau et al., 1995; Auguste, 2009), especially red deer and horse. In the thin fluvial deposits of the middle terrace that correspond to the MIS 10/9 transition, level I1 (**Figure 3**) covered a surface of 148 m² and yielded roughly 3000 lithics artefacts associated with teeth and bones of large mammals (Auguste, 2012).

Flint is the only raw material used as toolstone. The rarity of tested nodules and cores compared to the large number of handaxe fragments and bifacial tools made on gelifracts identify the site as a kill and butchery site (Lamotte and Tuffreau, 2001).

Aurochs *(Bos primigenius)* is the main taxa at Cagny-l'Épinette (**Table 1**); red deer *(Cervus elaphus)* is the second most abundant. *Equus* cf. *mosbachensis* is also present but with fewer remains. Other taxa are present but rare: a large cervid, likely giant deer *(Megaloceros giganteus)*; fallow deer *(Dama dama clactoniana)*; European ass *(Equus hydruntinus)*; narrow-nosed rhinoceros *(Stephanorhinus hemitoechus)*; straight-tusked elephant *(Palaeoloxodon antiquus*); hyena (cf. *Crocuta spelaea)*; and fox *(Vulpes* sp.).

The huge quantity of bones with no taphonomic modifications favours the interpretation of a rapid burial of the accumulation. Some aurochs and red deer bones show marks caused by water flow and carnivore gnawing; many more bones exhibit cut marks indicating dismembering, defleshing, tongue extraction and detachment of tendons. Long bones reveal typical breakage patterns characterised by direct percussion on fresh bone to extract marrow. Bones of other species exhibit no anthropic modifications and possibly no relationship with Neanderthal activities.

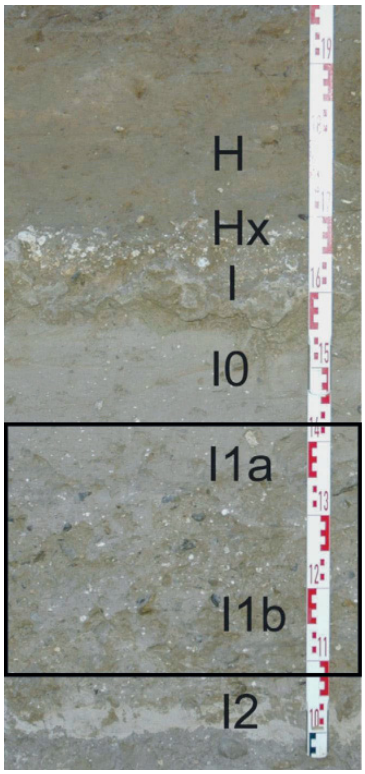

Figure 3 Cagny-l'Épinette. Thin fluvial deposits (I to I2) and upper levels (H and Hx) (after Tuffreau et al., 2008).

The six bone retouchers from Cagny-l'Épinette (**Table 2**) are among the oldest known retouchers in Europe, and are fully described by Auguste (in Moigne et al., 2016). The bone tools originate from levels I1A and I1B. Four retouchers were made from aurochs bones and two from horse. No bones of red deer were used despite their abundance at the site.

Three retouchers were made on distal humeri: one from horse and two from aurochs (**Figure 4A, 4C**). The use areas of the three humerus retouchers are situated on the medial part of the distal epiphysis, similar to those in the La Quina historical collec-

Table 1 Inventory of the large mammals from Cagny-l'Épinette level I1, with NISP (number of identified specimens) and MNI (minimum number of individuals).

Taxon	NISP	MNI
Bos primigenius	1642	61
Cervus elaphus	664	35
Equus cf. *mosbachensis*	54	15
Dama clactoniana	17	6
Paleoloxodon antiquus	4	2
Megaloceros giganteus	2	1
Stephanorhinus hemitoechus	2	1
Equus hydruntinus	1	1
Crocuta spelaea	1	1
Vulpes sp.	-	-
Total	2387	123

tion. In addition to retouching activities, their use is hypothesised to relate to the shaping of handaxes or bifacial tools (Vincent, 1993). However, the damage to the humeri does not suggest a particular method of use. The bones were not used as anvils, as the stigmata are located on the trochlea and not on the cranial face (Moigne et al. 2016). Some of the diaphysis remains on two of the humeri, but this did not offer much for gripping the bone or provide for good rotation of the wrist. Nevertheless, the use of these humerus fragments as retouchers is possible (Vincent, 1993).

The pits and scores appear different on each bone. For the horse humerus, the use area on the trochlea features deep, triangular pits, all oriented perpendicular to the medial-lateral axis of the distal articulation. This retoucher has a second use area on the diaphysis, with large, ovoid and triangular pits oriented perpendicular to the long axis of the bone. On this scaled area, some large, oblique and rectilinear scores are also noted. These scores have rough sides and were imparted after the initial intensive utilization as a retoucher. Concerning one of the two aurochs humeri, the pits are triangular rather than ovoid; the scores are rectilinear and smooth. The other aurochs humerus presents deep and superimposed triangular pits, all oriented perpendicular to the medial-lateral axis of the distal articulation; the scores are rectilinear and generally smooth.

About the three other retouchers, two are made on horse and aurochs metatarsals and the last is on an aurochs humerus diaphysis (see **Figure 4B**). The numerous scores on the horse metatarsal are deep and rectilinear, with rough and asymmetrical sides, and sometimes covered by deep triangular pits. This may indicate the bone was of intermediate freshness (Mallye et al., 2012). The location of the use area, centred on the diaphysis, is different than on the aurochs metatarsal and humerus, which exhibit a more typical use area location positioned toward the extremity of the bone (Mallye et al., 2012).

In conclusion, the main features of the retouchers from Cagny-l'Épinette are the use of thick bones from large herbivores (aurochs and horse) and a clear pattern of retouchers on humerus and metatarsal diaphyses. The distal articulation of the humerus was also used, which may have required more strength and skill than with the diaphysis fragments (Vincent, 1993). Based on characteristics of the pits and scores, the retouchers were intensively used. Moreover, there is a diversity of pits and scores, even

Table 2 Inventory and general data on the retouchers from Cagny-l'Épinette (after Moigne et al., 2016). Length (L), width (W) and thickness (T) dimensions are in mm.

Inventory number	Level	Taxon	Bone	Use area location	L	W	T
Ep90-20V-50	I1	*Equus mosbachensis*	humerus	Lateral shaft, distal articulation	210	90	86
Ep93-22U-39	I1B	*Equus mosbachensis*	metatarsal	Lateral diaphysis	172	35	20
Ep95-25T-12	I1B	*Bos primigenius*	metatarsal	Lateral diaphysis	90	26	25
Ep2000-25O-318	I1B	*Bos primigenius*	humerus	Distal articulation	150	102	95
Ep2007-1647	I1A	*Bos primigenius*	humerus	Distal articulation	165	90	90
Ep2008-26I/J-2342	I1B	*Bos primigenius*	humerus	Proximal diaphysis	150	80	40

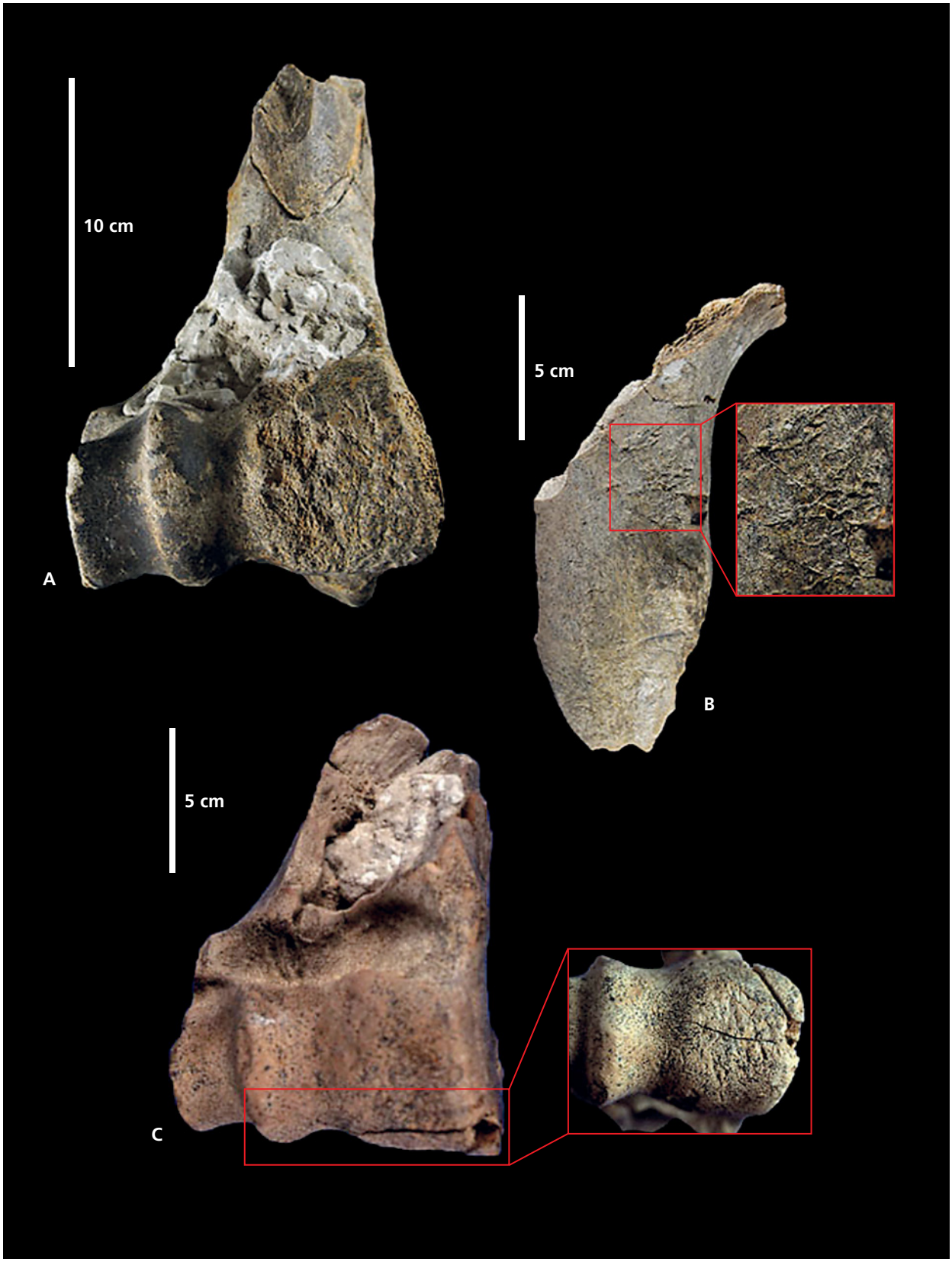

Figure 4 Cagny-l'Épinette. A) Aurochs right humerus (Ep 2007.1647, I1A) with one use area on the trochlea, cranial view (photos by Noémie Sévêque). B) Aurochs right humerus (Ep 2008.26I/J-2342, I1B) with a helical fracture and one use area, cranio-medial view (photos by Noémie Sévêque). C) Aurochs right humerus (Ep 2000.25O-318, I1B) with a helical fracture and one use area on the trochlea, distal view (photos by Patrick Auguste, modified by Noémie Sévêque).

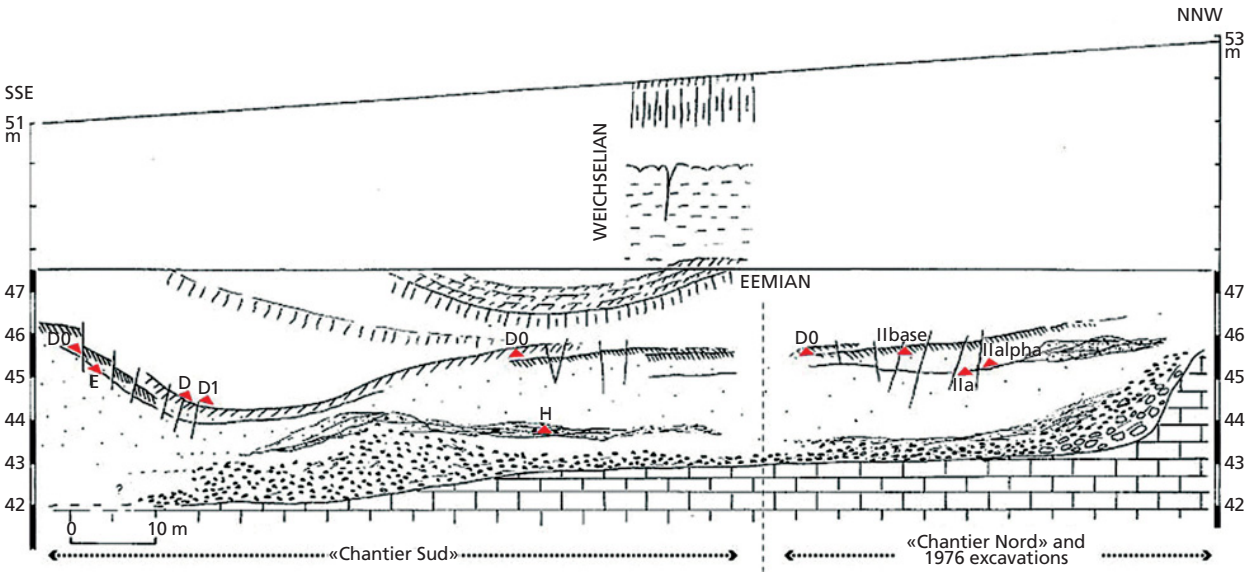

Figure 5 Biache-Saint-Vaast. Synthetic representation of the sedimentary sequence and locations of the archaeological levels (Hérisson 2012, after Tuffreau and Sommé, 1988).

though flint was the only worked raw material. This could be explained by the use of bones of variable freshness, from green to moderately fresh (Mallye et al., 2012; Moigne et al. 2016).

Biache-Saint-Vaast

The site of Biache-Saint-Vaast, excavated between 1976 and 1982 under the direction of Alain Tuffreau, revealed eleven levels of hominin occupation within the terraces of the river Scarpe (Tuffreau and Sommé, 1988). The stratigraphy shows a succession of overlapping fluvial and slope deposits capped by a loess sequence (**Figure 5**). Level IIa delivered tens of thousands of large mammal bone remains, many lithic artefacts, as well as two Neanderthal skulls. Teeth and bones submitted for ESR dating returned ages of 229 ± 27 ka and 230 ± 24 ka (Bahain et al., 1993, 2007), which coincides with the beginning of MIS 7.

The lithic artefacts discovered at Biache-Saint-Vaast constitute one of the oldest Middle Palaeolithic assemblages. Levallois *chaîne opératoire* flake production is present in all levels, and flint was the only raw material. Level IIa also yielded a large assemblage of this Mousterian lithic technology dominated by scrapers and elongated flakes (Hérisson, 2012).

The assemblage of 214,860 faunal remains was studied in its totality (Auguste, 1995b); however, only 20,655 were identified to skeletal part and taxon. The list of the large mammals identified in the whole fluvial sequence (levels I to D0) at Biache-Saint-Vaast includes twenty taxa (**Table 3**). The large mammals from the loess sequence (levels D1 and D) are less numerous than from the fluvial deposits and include only seven taxa. In total, 626 individual animals were identified.

For the fluvial sequence (levels I to D0), the fauna is very homogeneous and corresponds to a mixed woodland and meadow environment with a temperate and humid climate. In contrast, the fauna from the loess sequence (levels D1 and D) indicates a colder, drier and more continental climate. The environment was more open and the steppe began to appear.

Aurochs *(Bos primigenius)* is the most represented species in the combined levels at Biache-Saint-Vaast (**Figure 6**), with 31.3% of the total minimum number of individuals (MNI). The aurochs population is represented by a minimum of 196 individuals, and adults dominate the mortality profile (**Figure 7**). Following the aurochs, the brown bear *(Ursus arctos)* is the second most represented species, with 13.9% of the MNI. Narrow-nosed rhinoceros *(Stephanorhi-*

Table 3 Composition of the large fauna from all levels at Biache-Saint-Vaast (after Auguste, 2012), with NISP (number of identified specimens) and MNI (minimum number of individuals).

	D		D1		D0		IIb		IIalpha		IIa		En		F		G		H		I		HS		Total	
Taxon	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI
Coelodonta antiquitatis	12	3	22	2																					34	5
S. hemitoechus					2	1	21	4	77	8	942	54	12	3	3	1			8	3	1	1	4	3	1070	78
S. kirchbergensis					1	1	4	2	8	3	101	12	4	2					3	2			2	2	123	24
Stephanorhinus sp.					17	3	37	4	98	5	1703	28	52	4			5	2	9	3			2	1	1923	50
Capreolus capreolus					1	1	12	1			36	4	1	1											50	7
Cervus elaphus	13	1	17	1	18	3	33	5	6	1	133	12									1	1	2	1	223	25
Megaloceros giganteus					1	1	1	1	2	2	90	6							1	1					95	11
Castor fiber																			2	1					2	1
Canis lupus											2	1													2	1
Equus cf. *achenheimensis*	28	3	15	2	15	2	26	3			74	5	1	1	1	1	1	1			4	2	1	1	166	21
Equus hydruntinus	3	1	1	1	1	1	7	2			13	1	1	1	1	1									27	8
Felis silvestris											8	1													8	1
Aonyx antiqua											19	2													19	2
Martes cf. *martes*											2	1													2	1
Palaeoloxodon antiquus			1	1							13	1	1	1	1	1			6	1			1	1	23	6
Panthera spelaea											3	1													3	1
Sus scrofa					8	2			3	1	85	8	4	1											100	12
Vulpes vulpes	1	1									2	1													3	2
Ursus arctos					19	3	30	2	108	12	2050	63	15	1			1	1	17	2			3	3	2243	87
Ursus deningeri							17	2	15	1	189	16	5	1											226	20
Ursus sp.							58	5	210	7	4240	48	32	3	1	1					1	1	2	2	4544	67
Bos primigenius	48	4	29	4	35	4	268	10	572	18	8616	140	99	4	5	1			66	5	18	1	13	5	9769	196
Total	105		85	11	118	22	514	41	1099	58	18321	405	227	23	12	6	7	4	112	18	25	6	30	19	20655	626

nus hemitoechus) accounts for 12.5% of the MNI (see **Figure 6**). The brown bear mortality profile also shows a dominance of adults, which indicates selective hunting by Neanderthals (see **Figure 7**), but the rhinoceros shows a different mortality structure, with more young and old individuals (Auguste, 1995c).

Systematic butchery activities are observed on the aurochs assemblage; butchery is less systematic on brown bear and rhinoceros (Auguste, 2012). For the fluvial deposits, Neanderthals broke almost all aurochs long bones. Overall, cut marks on aurochs, brown bear and rhinoceros are numerous in level IIa, and indicate defleshing, tongue extraction and skinning.

Biache-Saint-Vaast provided a total of 333 retouchers (**Table 4**), one of the largest collections of these bone tools from the Palaeolithic. Auguste (2002) provided a full description of the Biache-Saint-Vaast retoucher assemblage, together with those from Kůlna Cave, Czech Republic. The majority (303) of retouchers from Biache-Saint-Vaast derive from level IIa.

Roughly 57% of the retouchers were made on aurochs long bones (**Table 5**); only 6% were made on bear bones. It is important to note that at Biache-Saint-Vaast, the brown bear remains are not intrusive, but rather bear was hunted and consumed like the herbivores, and the bones preserve all the same butchery and skinning marks. Moreover, brown bear is the second most abundant species at the site, with a minimum of 87 individuals. Four rhinoceros long bones were also used as retouchers.

Nearly all (96%) retouchers are on long bones. Tibia diaphyses are the most represented, with 17.1% of the total, and radio-ulna diaphyses account for a further 9.7%. These frequencies are similar across all species and seem to represent a deliberate choice made by Neanderthals. Other bones used as retouchers include mandible, vertebra, rib, scapula, os coxa, and the distal epiphysis of a femur (Auguste, 2002).

The majority (84%) of the bone tools from Biache-Saint-Vaast present only one use area (**Table 6**; **Figures 8-12**), while 14% include two use areas

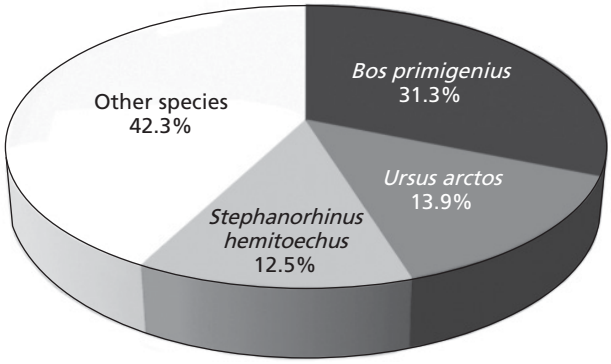

Figure 6 Biache-Saint-Vaast. Composition of the large fauna in MNI (minimum number of individuals) for all levels (after Auguste, 2012).

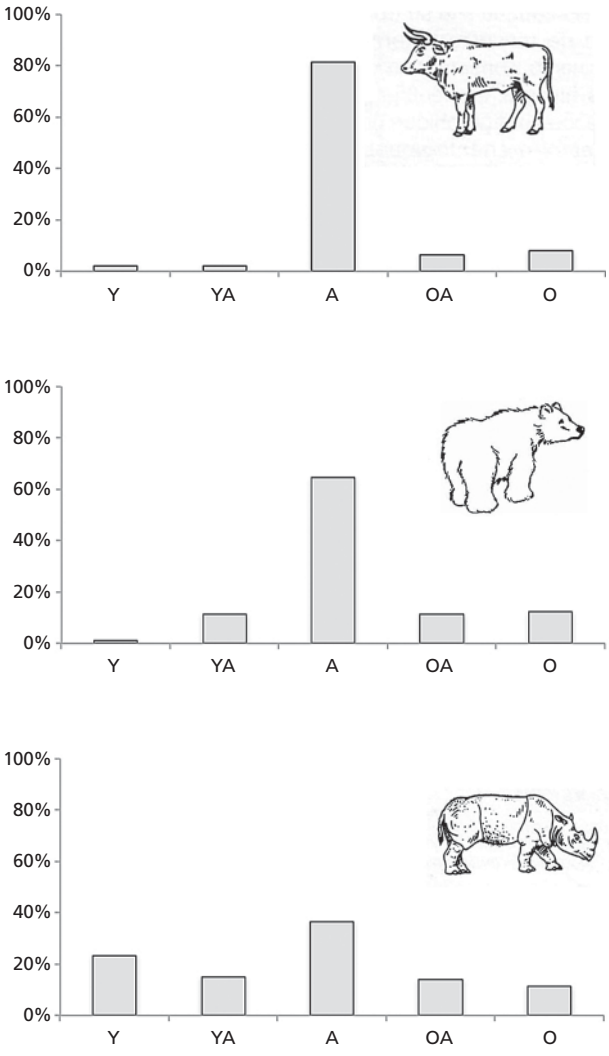

Figure 7 Biache-Saint-Vaast. Mortality profiles of aurochs (top), bear (middle) and rhinoceros (bottom) from all levels (after Auguste, 1995c). Y = young; YA = young adult; A = adult; OA = old adult; O = old.

Table 4 Inventory of retouchers on long bones and other bones by level at Biache-Saint-Vaast (after Auguste, 2002), with NISP (number of identified specimens).

	Long bones		Others bones	
Level	NISP	%	NISP	%
II a	291	90.65	12	100
II alpha	26	8.1	0	0
II b	4	1.25	0	0
Total	321	100	12	100

Table 5 Inventory of retouchers on long bones and other bones by species at Biache-Saint-Vaast (after Auguste, 2002), with NISP (number of identified specimens).

	Long bones		Others bones	
Taxon	NISP	%	NISP	%
Bos primigenius	184	57.32	11	91.67
Ursus arctos	20	6.23	0	0
Stephanorhinus hemitoechus	4	1.25	0	0
Undetermined	113	35.20	1	8.33
Total	321	100	12	100

Table 6 Inventory of retouchers on long bones and other bones by number of use areas at Biache-Saint-Vaast (after Auguste, 2002), with NISP (number of identified specimens).

Number of use areas	Long bones		Others bones	
	NISP	%	NISP	%
1	271	84.4	12	100
2	48	14.9	0	0
3	2	0.63	0	0
Total	321	100	12	100

(**Figures 13, 14**). Three use areas are visible only on two retouchers. In cases with multiple use areas, stigmata are located on the same face of the bone, but on opposite edges. The overall shapes of stigmata are homogeneous, with numerous pits and rectilinear scores of different depths and lengths. Almost 72% of the stigmata are oriented perpendicular to the main axis of the bone. For the other retouchers, the stigmata are more oblique to the long axis, ranging from 30-60° and 90-120°.

Of the 333 retouchers, additional modifications have been identified on 212 bones. Scraping marks occur on 43% of the retouchers, 22% include cut marks, and 5% have helical fractures. Only two bones present all of these modifications together. The data indicate that at Biache-Saint-Vaast there are modifications linked to butchery activities and the preparation of the bones surfaces before their use as retouchers. Indeed, cut marks and helical fractures are typical elements of butchery, and they are identified on a many bones unrelated to retouchers. On the other hand, the predominance of scraping marks indicates an intentional preparation of the bones for their use as retouchers.

Le Rozel

The site of Le Rozel, discovered in 1963 by Yves Roupin owing to coastal erosion, is located on the west coast of the Cotentin Peninsula, close to Surtainville Beach. Neanderthals occupied one of the rockshelters of the cliff during the early stages of the last glaciation, dating to 115-70 ka by OSL. Frédéric Scuvée directed the first excavations in 1968 (Scuvée and Vérague, 1984; van Vliet-Lanoë, 1988; van Vliet-Lanoë et al., 2006). Due to the increased threat of coastal erosion at the site, it was decided to initiate new excavations in 2011 before its destruction. Dominique Cliquet now directs the excavations. This new research indicates that Le Rozel is an exceptional Middle Palaeolithic site with at least three different Neanderthal occupations (**Figure 15**) (Cliquet and Tribouillard, 2015). The state of preservation of the archaeological remains is very good. Currently, there are more than 200 Neanderthal footprints, well-preserved hearths, insect remains, potential anvils, and thousands of large and small mammal remains preserved as a result of the calcareous sandstone.

Flint is the principal raw material for stone tools in all the three levels, but quartz and sandstone were exploited as well. So far, five knapping areas have been discovered, four of which are associated with butchery areas. Three types of debitage were used: Levallois, direct and laminar knapping. The only tools are scrapers.

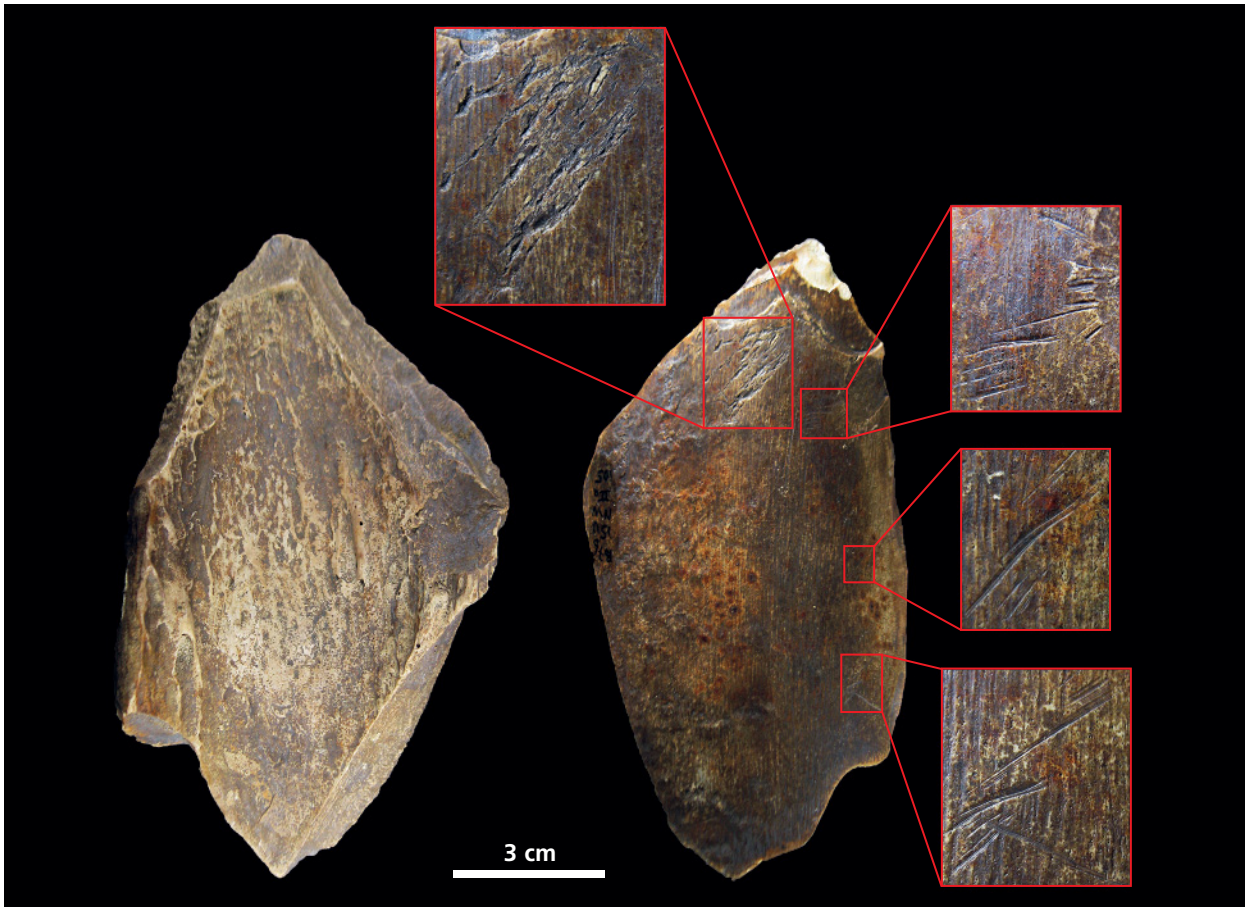

Figure 8 Biache-Saint-Vaast. Aurochs femur (B76, IIa , 15U NW, 105) with a helical fracture, impact notch, negative flake scar, cut marks and one use area; medullary (left) and cortical (right) views (photos by Noémie Sévêque).

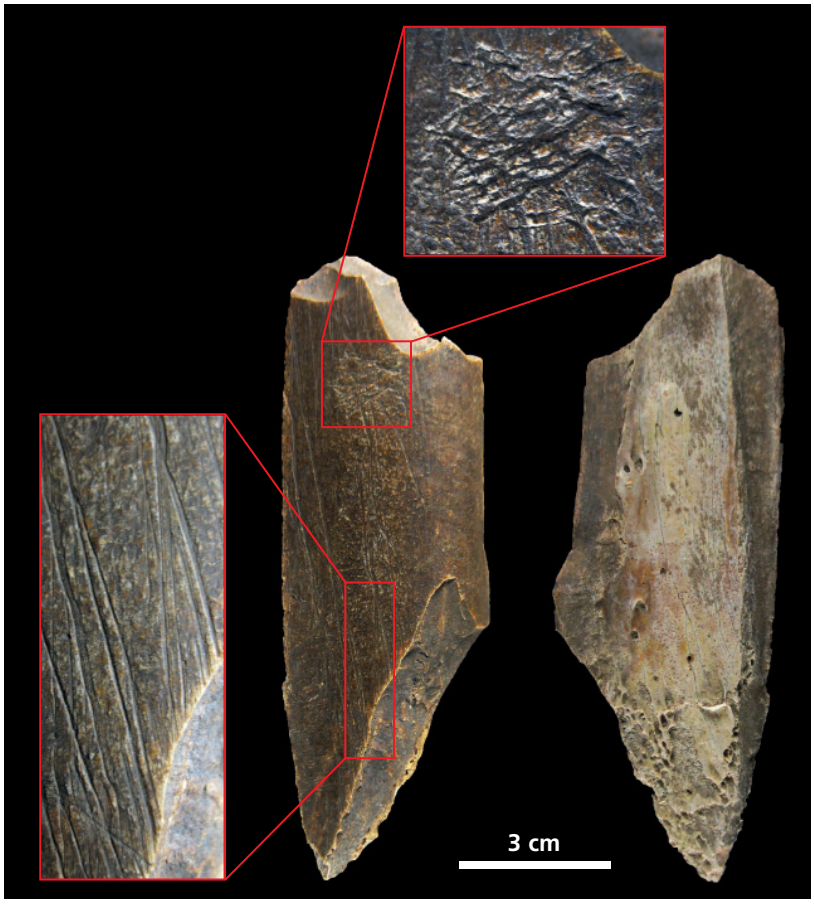

Figure 9 Biache-Saint-Vaast. Aurochs tibia (B76, IIa, 31Y) with a helical fracture, cut marks, scraping marks and one use area; cortical (left) and medullary (right) views (photos by Noémie Sévêque).

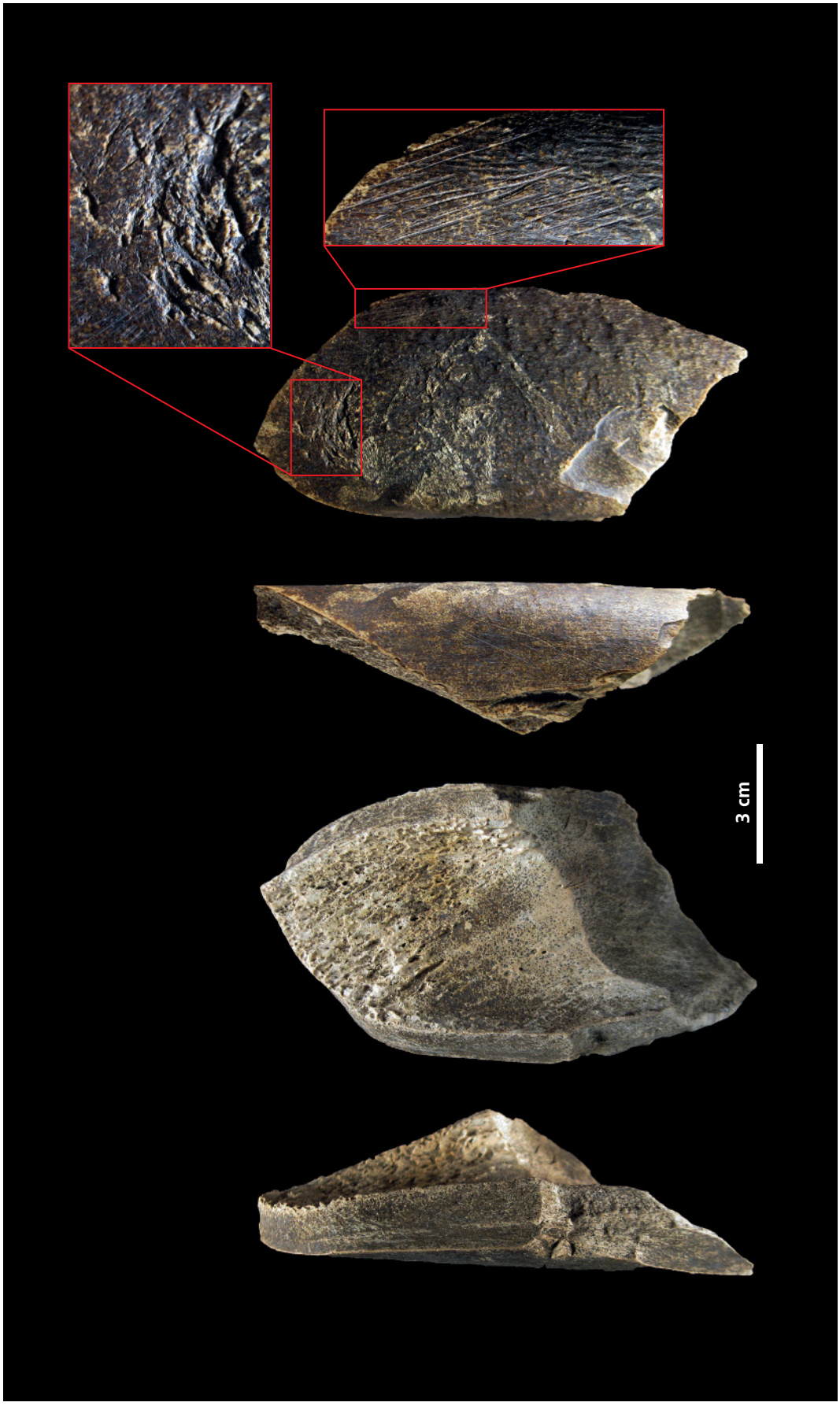

Figure 10 Biache-Saint-Vaast. Aurochs tibia or radius (B76, IIa, 33V) with a helical fracture, cut marks and one use area; lateral, medullary, lateral and cortical views (from left to right) (photos by Noémie Sévêque).

Figure 11 Biache-Saint-Vaast. Aurochs long bone (B76, IIa, 28V SW) with a helical fracture, cut marks and one use area; medullary (left) and cortical (right) views (photos by Noémie Sévêque).

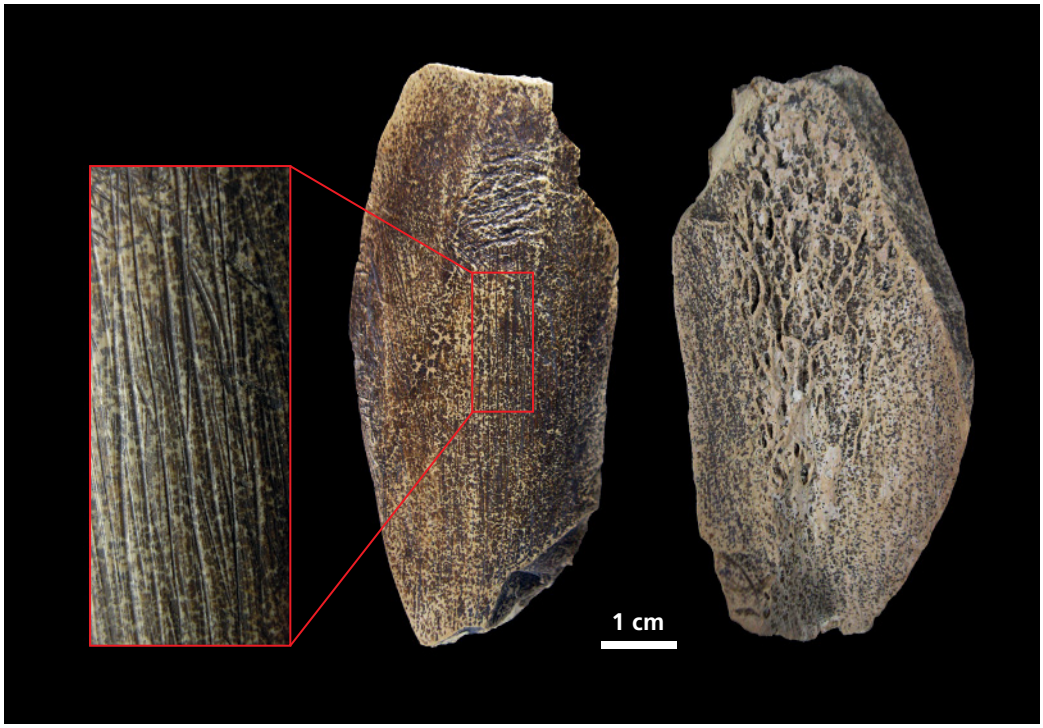

Figure 12 Biache-Saint-Vaast. Bear long bone (B76, IIa, 27G, 17) with a helical fracture, cut marks, scraping marks and one use area; cortical (left) and medullary (right) views (photos by Noémie Sévêque).

Figure 13 Biache-Saint-Vaast. Aurochs tibia (B76, IIa, 34R, 5) with a helical fracture, impact notch, negative flake scar, cut marks, scraping marks and two use areas; cortical, lateral and medullary views (from left to right) (photos by Noémie Sévêque).

Figure 14 Biache-Saint-Vaast. Aurochs left radius (B76, IIa, 11I, R8994) with a helical fracture, cut marks, scraping marks and two use areas; dorsal, lateral and palmar views (from left to right) (photos by Noémie Sévêque).

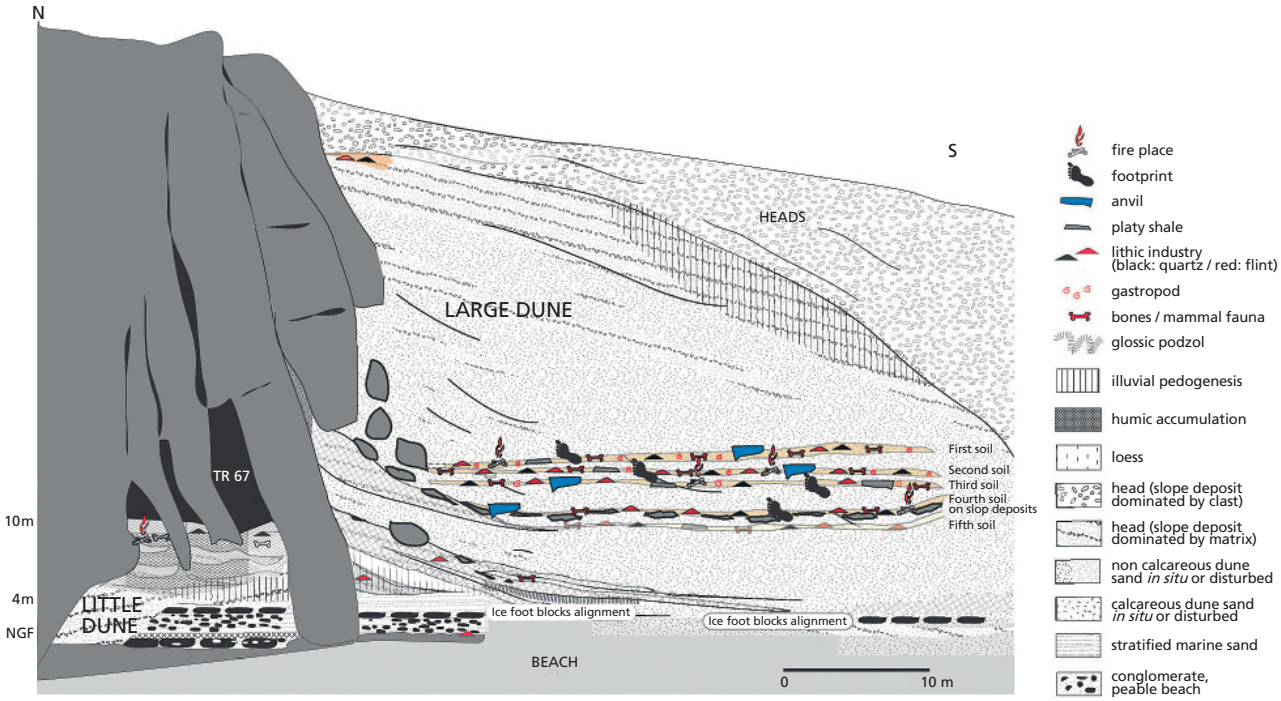

Figure 15 Le Rozel. Synthetic section of sedimentary deposits and locations of the archaeological levels (after Cliquet and Tribouillard, 2015).

To date, 4711 faunal remains have been studied (Cliquet and Tribouillard, 2015). The preservation of bones is extraordinary, making for a high percentage of identifiable remains. The large mammal spectrum (**Table 7**) includes a minimum of 12 red deer *(Cervus elaphus)*, five horses *(Equus* sp.), one aurochs *(Bos primigenius)*, one roe deer *(Capreolus capreolus)*, one rhinoceros (cf. *Stephanorhinus hemitoechus)*, one elephant (cf. *Palaeoloxodon antiquus)* and one rabbit *(Oryctolagus cuniculus)*. Seasonality was established on mandibles of two red deer fawns (six to eight months old) and one horse foal (ten months old). The season of occupation coincides with winter and the beginning of spring (December-April).

Butchery activities are clear at this site, with hundreds of faunal remains showing breakage for marrow extraction, cut marks and scraping marks. The long bones of red deer are almost always broken for marrow extraction. Breakage is less systematic on aurochs and horse long bones, but still prevalent. Various cut marks related to defleshing, skinning and tongue extraction are present on 225 bones. Scraping marks are observed on 37 bones, 12 of which were also used as retouchers.

Figure 16 Le Rozel. Red deer left femur (LR 2012, n°2028) with a helical fracture, cut marks and one use area; cortical (left) and medullary (right) views (photos by Noémie Sévêque).

So far, 38 retouchers have been found in only three years of excavations running from 2012 to 2014. Red deer limb bones were the most used (**Figures 16-19**), with 28 retouchers (**Table 8**). A mandible from a red deer was also used. Besides cervid, four retouchers were made with aurochs limb bones (**Figure 20**), three with horse limb bones (**Figure 21**) and two with indeterminate large herbivore bones. Considering we identified only one aurochs and five horse individuals in the assemblage, it is notable that there are more aurochs than horse bones used as retouchers. Neanderthals seem to have preferred to utilize the aurochs carcass compared to the horses.

Concerning the anatomical elements used (**Figure 22**), retouchers are better represented on hind limbs (12 tibiae and seven femora) than on fore limbs (one humerus and three radii). But, metacarpals outnumber metatarsals (5:3). This pattern does not necessarily reflect a deliberate choice, since there is a significant difference in the ratio of hind limb (91 fragments of femur and tibia) to fore limb (42 fragments of humerus, radius, and ulna) in the

Table 7 Inventory of the large mammals from Le Rozel, with NISP (number of identified specimens) and MNI (minimum number of individuals).

Taxon	NISP	MNI	Details of MNI
Cervus elaphus	570	12	9 adults, 3 young
Equus sp.	50	5	4 adults, 1 young
Bos primigenius	25	1	1 adult
Capreolus capreolus	3	1	1 adult
cf. *Stephanorhinus hemitoechus*	20	1	1 young
cf. *Palaeoloxodon antiquus*	1	1	1 adult
Oryctolagus cuniculus	3	1	1 adult
Total	672	22	

Table 8 Inventory of retouchers on long bones and other bones by species at Le Rozel, with NR (number of remains).

	Long bones		Others bones	
Taxon	NR	%	NR	%
Cervus elaphus	28	77.78	1	50
Bos primigenius	4	11.11	0	0
Equus sp.	3	8.33	0	0
Large herbivore	1	2.78	1	50
Total	36	100	2	100

Figure 17 Le Rozel. Red deer femur (LR 2012, n°1214) with a helical fracture, cut marks and two use areas; cortical, lateral, medullary and lateral views (from left to right) (photos by Noémie Sévêque).

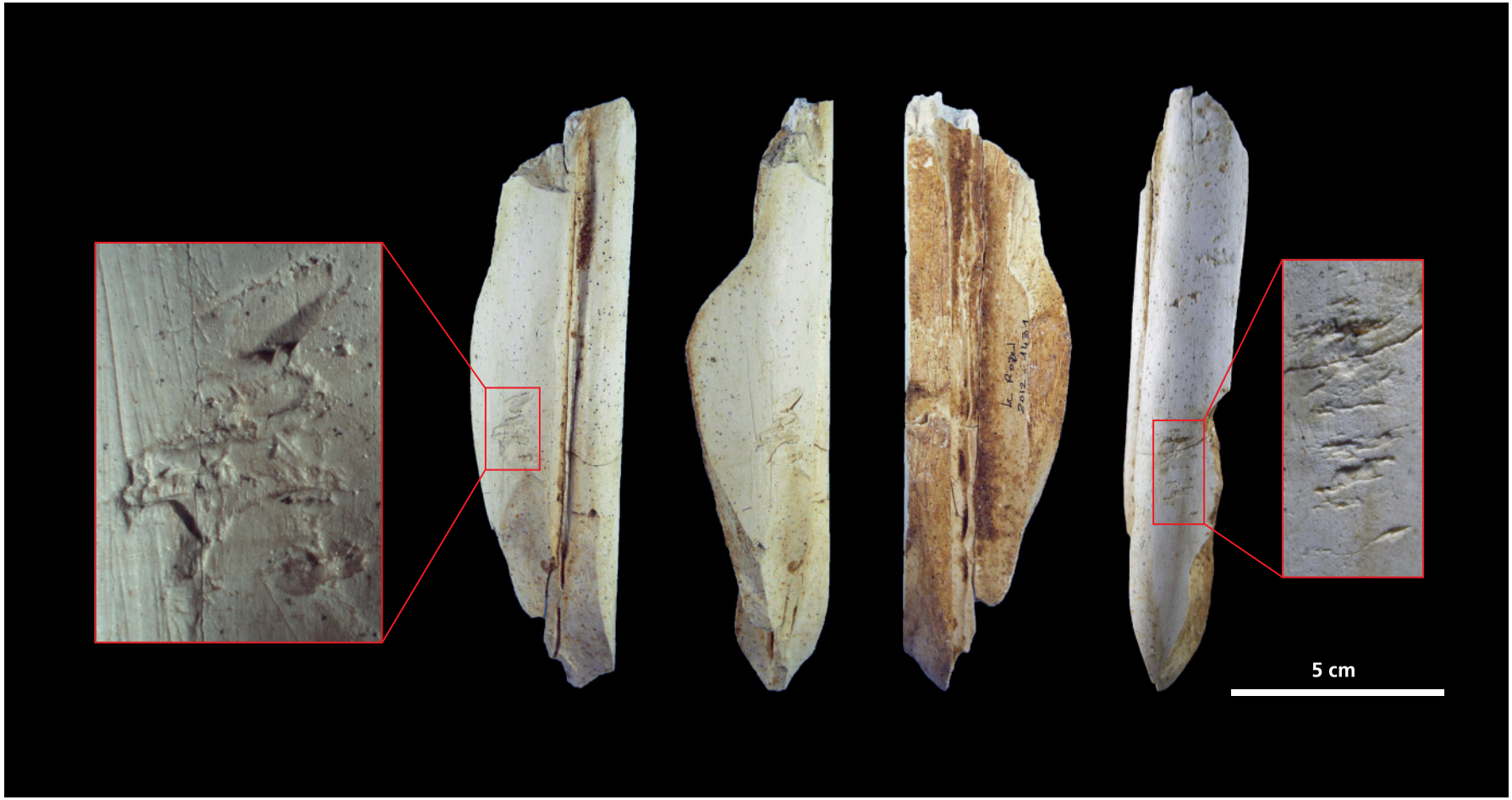

Figure 18 Le Rozel. Red deer metatarsal (LR 2012, n°1431) with a helical fracture, cut marks, scraping marks and three use areas; dorsal, lateral, palmar and lateral views (from left to right) (photos by Noémie Sévêque).

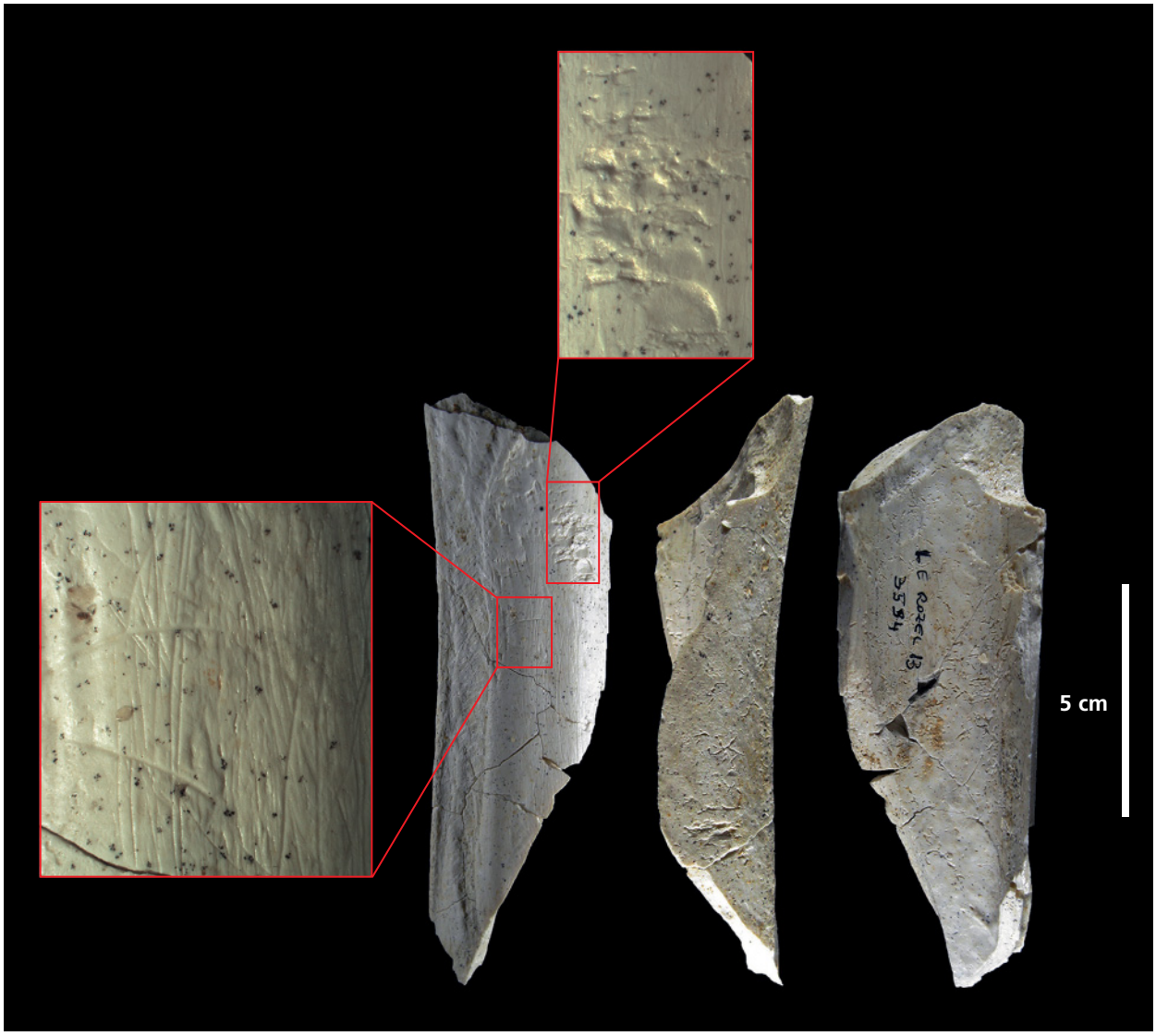

Figure 19 Le Rozel. Red deer left femur (LR 2013, n°3594) with a helical fracture, impact notch, negative flake scar, cut marks, scraping marks and two use areas; medial, lateral and medullary views (from left to right) (photos by Noémie Sévêque).

whole assemblage. Thus, the elements used for retouchers merely reflect the anatomical composition of the faunal assemblage.

Concerning the utilised red deer mandible, the area of retouching is situated on the lingual part of the bone, below the first premolar (**Figure 23**). The scores are numerous. Despite the thin appearance, the bone did not break during the action of retouching. Other sites also include similar implements, like the utilised reindeer mandible at La Quina (Verna and d'Errico, 2011), three aurochs mandibles from Biache-Saint-Vaast (Auguste, 2002) and a giant deer mandible at De Nadale Cave (Jéquier et al., 2015). Even if long bone diaphyses are often the most used (Vincent, 1993; Armand and Delagnes, 1998; Daujeard, 2014), the use of mandibles is not so rare.

At Le Rozel, the general pattern of retoucher use is the same as at Biache-Saint-Vaast: there is no selection for species or skeletal parts. Neanderthals used the species and the bones that were the most abundant.

Looking to the limb bones, only the diaphyses were used as retouchers. In most cases, pits and scores are situated on the extremities of the fragments, even if there are multiple use areas. When the retouchers are small or less elongated, the use

Figure 20 Le Rozel. Aurochs right humerus (LR 2013, n°6629+6912) with a helical fracture, cut marks and one use area; cranial, lateral, medullary and medial views (from left to right) (photos by Noémie Sévêque).

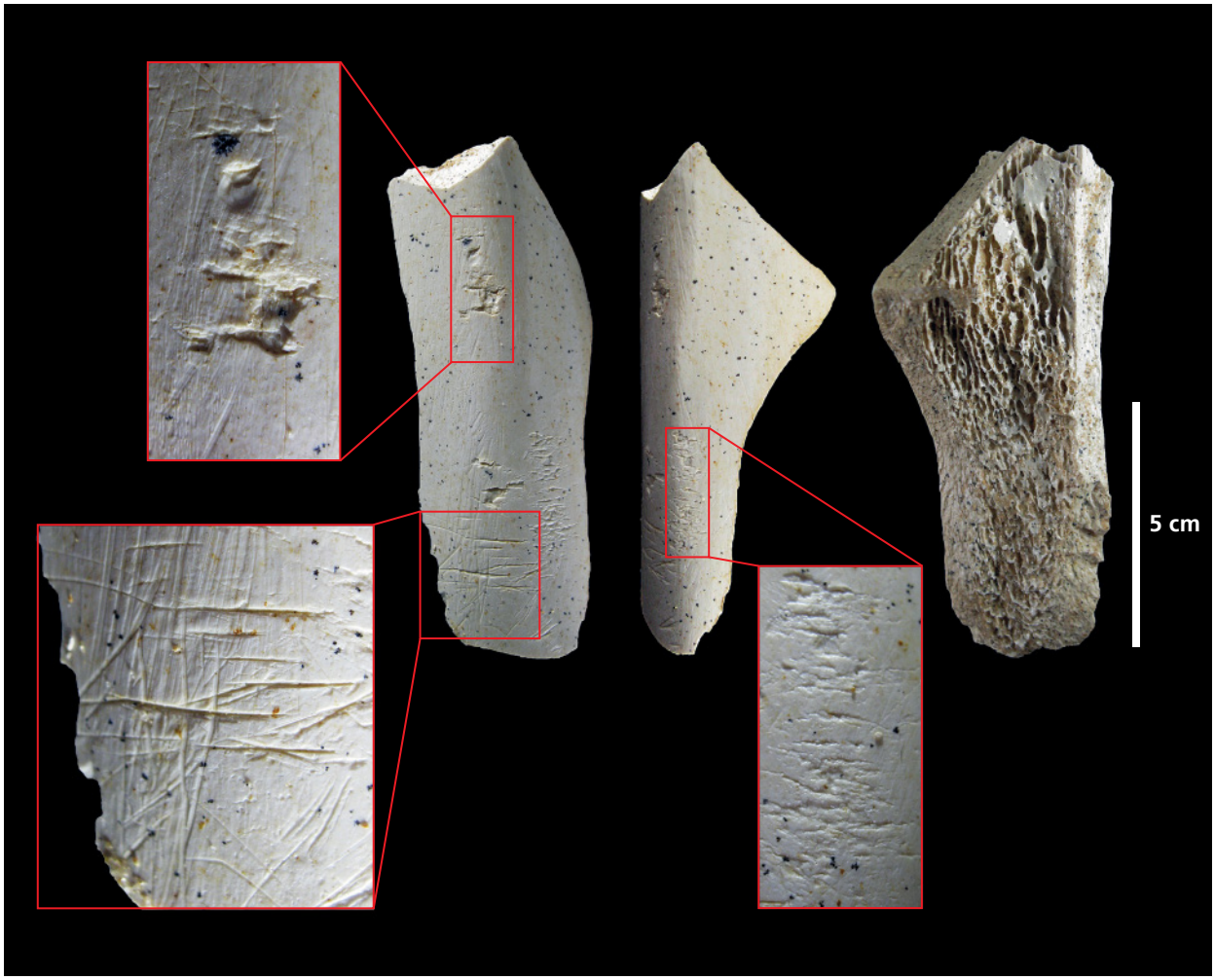

Figure 21 Le Rozel. Horse long bone (LR 2013, n°3559) with a helical fracture, cut marks, scraping marks and three use areas; cortical, lateral and medullary views (from left to right) (photos by Noémie Sévêque).

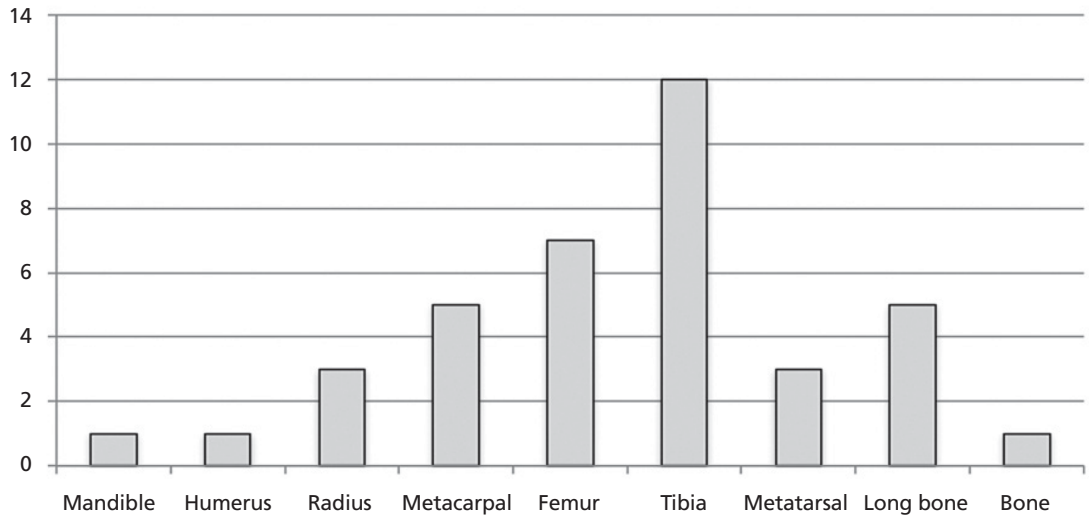

Figure 22 Number of specimens by anatomical element used as retouchers.

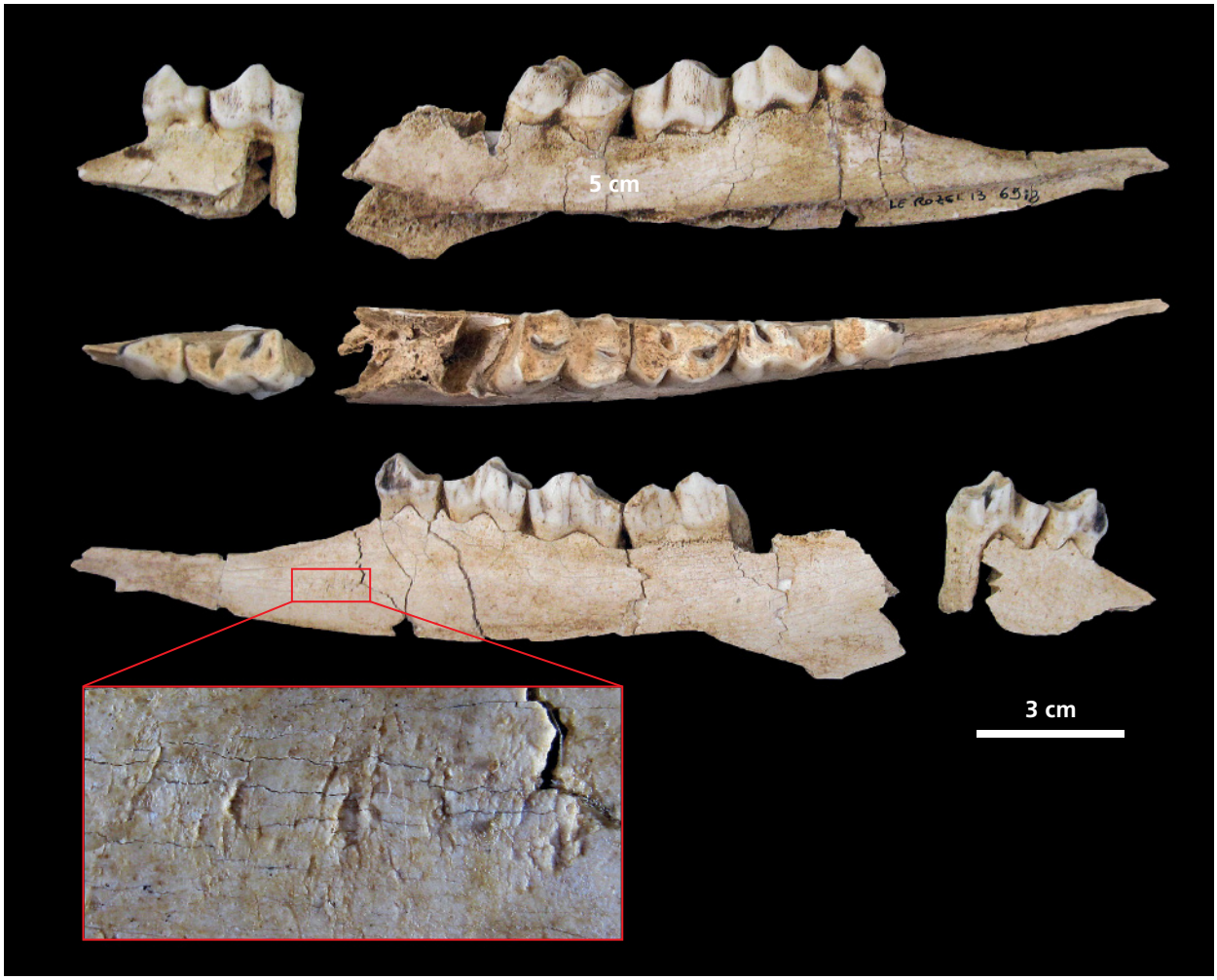

Figure 23 Le Rozel. Red deer left mandible (LR 2013, n°6703+6918) with one use area; vestibular, occlusal and lingual views (from top to bottom) (photos by Noémie Sévêque).

areas are located toward the centre of the bones. The surfaces where the stigmata are located are slightly convex or flat. For tibia diaphyses, the angles created by the different faces of the shaft often separate multiple use areas or mark the limits of the lone use area (**Figure 24**). Up to four retouching areas have been observed on a single bone (**Figure 25**), but one use area is the most common pattern, occurring on 25 of the 38 retouchers at Le Rozel. Nine retouchers present two use areas, and three others have three use areas (**Figure 26**). Differences can be seen in the use areas: some present only a few scores (**Figure 27**), while others show a much higher number (**Figure 28**).

Retouching areas also occur frequently with other anthropic modifications, such as helical fractures, cut marks and scraping marks. Thirty-five retouchers present helical fractures made on green bones before their use as retouchers, 29 bone tools are cut-marked (**Figure 29**), and 12 have scraping marks. Cut and scraping marks were identified together on eleven retouchers. One interesting point is that all retouchers with three and four use areas, and two of nine with two use areas, present scraping marks on the surface. In contrast, only one of the 25 retouchers with one use area shows scraping damage. Scraping marks are usually made while preparing the bone surfaces for use as retouchers. At Le Rozel, it is clear that scraping is almost exclusive to retouchers with multiple use areas. This may imply that Neanderthals knew from the onset whether the bone would be used multiple times as a retoucher.

If it was to be used only once, scraping the bone surface was not necessary. On the other hand, if the bones were to be used again, scraping was necessary to prepare the entire cortical surface. This may suggest intentional preparation and predetermination by Neanderthals.

Mutzig

The site of Mutzig is located in Alsace, near the Vosges Mountains, at the end of the Bruche Valley. Mutzig is one of the few Middle Palaeolithic sites from northeastern France, thus essential for the comprehension of Neanderthal behaviour in this part of Europe.

After its discovery in 1992, Jean Sainty directed several surveys over the next four years (Sainty et al., 1993). Part of the sediment deposit was in open-air context and the remainder was under a sandstone rockshelter that had collapsed and covered the site with rocks from the Felsbourg Hill. This rockfall and the calcareous water coming from the hill protected many of the artefacts from destruction. In 2009, Jean Detrey and Thomas Hauck continued the surveys and made systematic excavations (**Figure 30**), since 2013 directed by Héloïse Koehler.

At least seven archaeological levels are present (5, 7a, 7c1, 7c2, 7d, 8, 9/10), dated to ca. 90 ka by OSL (Detrey and Hauck, 2011; Koehler and Wegmüller, 2015). In each level, hundreds of faunal and lithic artefacts are associated with hearth remains. Thus far, in terms of raw material and technology, the lithic industry is quite consistent throughout all the levels. Fifteen different raw materials were used, all coming from within 15 km surrounding the site (Koehler and Wegmüller, 2015; Koehler et al., 2016). Almost 7% of the lithic remains are tools.

At present, 2368 faunal remains have been studied (Koehler and Wegmüller, 2015; Koehler et al., 2016). The species present in Mutzig are: reindeer

Figure 24 Le Rozel. Red deer tibia (LR 2012, n°1179) with a helical fracture, cut marks and one use area; medullary (left) and cortical (right) views (photos by Noémie Sévêque).

Figure 25 Le Rozel. Red deer tibia (LR 2013, n°4334+4335) with a helical fracture, cut marks, scraping marks and four use areas; cortical, lateral and medullary views (from left to right) (photos by Noémie Sévêque).

(Rangifer tarandus); horse *(Equus* sp.); woolly mammoth *(Mammuthus primigenius)*; steppe bison (cf. *Bison priscus)*; woolly rhinoceros *(Coelodonta antiquitatis)*; a small bovid, possibly chamois *(Rupicapra rupicapra)*; wolf *(Canis lupus)*; fox (cf. *Alopex lagopus)*; bear *(Ursus* cf. *arctos)*; and beaver *(Castor fiber)*. Reindeer is the most represented species (**Table 9**), with a minimum of 24 individuals: nine juveniles, one young adult, thirteen adults and one old adult. Horse is the second most abundant species, with twelve individuals: five juveniles, five adults and one old adult could be reliably identified. Mammoth is represented by nine individuals based on teeth, which are overrepresented compared to the post-cranial skeleton. Few remains have been attributed to bison, but five individuals are represented among all the archaeological levels. Rhinoceros is represented by two individuals: one juvenile and one adult. Except for wolf, which has an MNI of two, all other species are represented by only one individual.

The material found in 2015 and 2016 allows for estimating the seasonality of occupation within the different levels at Mutzig (**Table 10**). For example, levels 7c2 and 9/10 show selective hunting of young reindeer (**Figure 31**), whereas levels 5 and 7c1 present no selectivity in hunting of any large mammals (Koehler and Wegmüller, 2015).

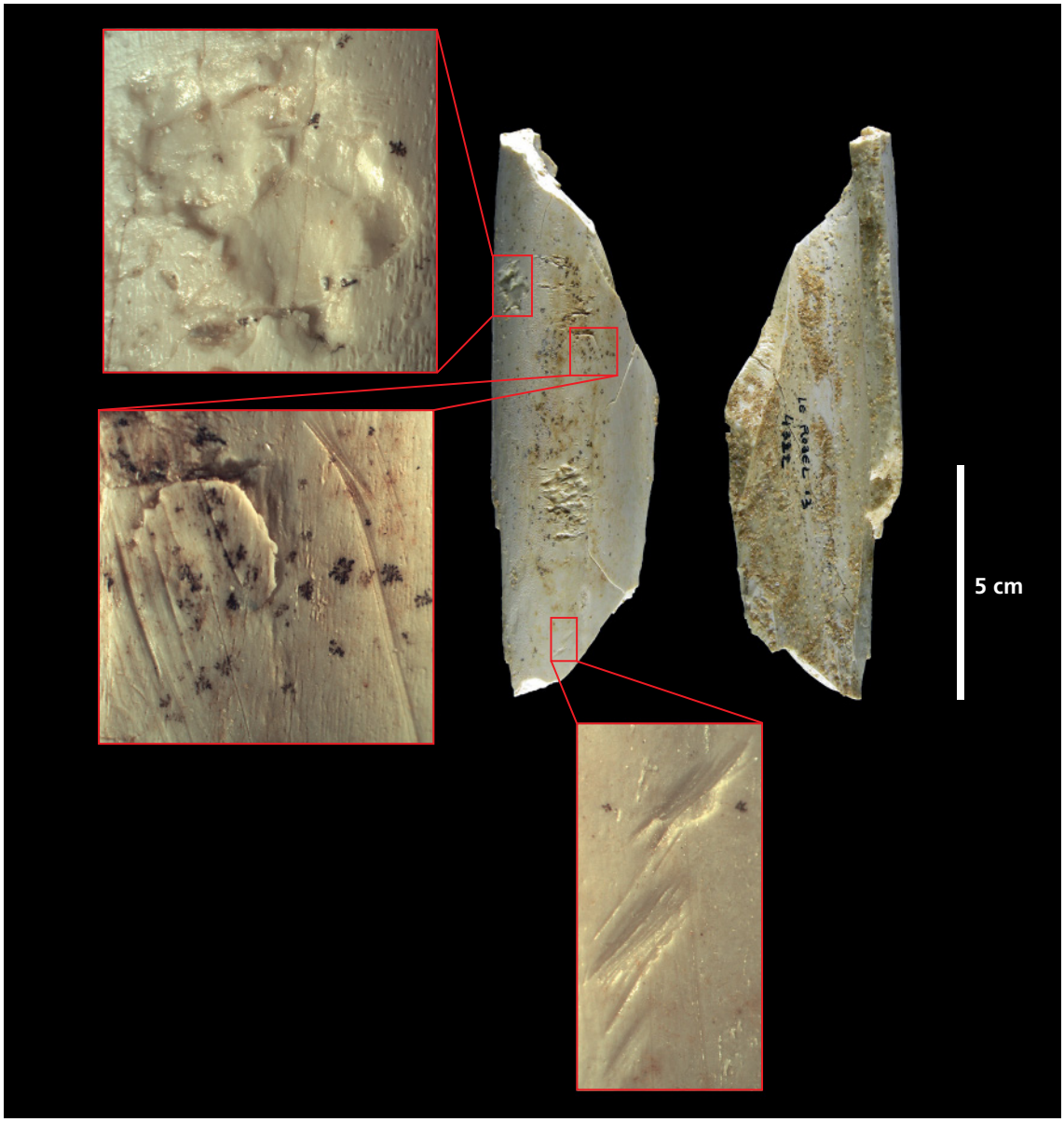

Figure 26 Le Rozel. Red deer tibia (LR 2013, n°4322) with a helical fracture, impact notch, negative flake scar, cut marks, scraping marks and three use areas; cortical (left) and medullary (right) views (photos by Noémie Sévêque).

The state of preservation of the faunal remains is variable. Some are very well preserved and others are weathered due to the acidity of the sediments. This could have prevented the identification of some butchery marks and retouch stigmata. So far, 1163 anthropic marks have been inventoried. Helical fractures are very common on reindeer long bones, but cut marks are quite rare. Scraping marks occur on only one bone.

So far, we identified only three retouchers from Mutzig. Two were discovered during the previous excavations in 1993 and 1994, the third came from the recent excavations in 2013. The retouchers were made with large mammal bones: two from red deer bones and the other from horse.

One reindeer tibia presents two areas of retouching located on the extremities of the bone (**Figure 32**). The pits are numerous and oriented roughly perpendicular to the long bone axis. Some pits are deep and large, indicating the use of substantial force. This bone also presents a helical fracture from marrow extraction.

Figure 27 Le Rozel. Red deer metacarpal (LR 2013, n°3976) with a helical fracture, impact notch, negative flake scar, cut marks and one use area; cortical, dorsal and medullary views (from left to right) (photos by Noémie Sévêque).

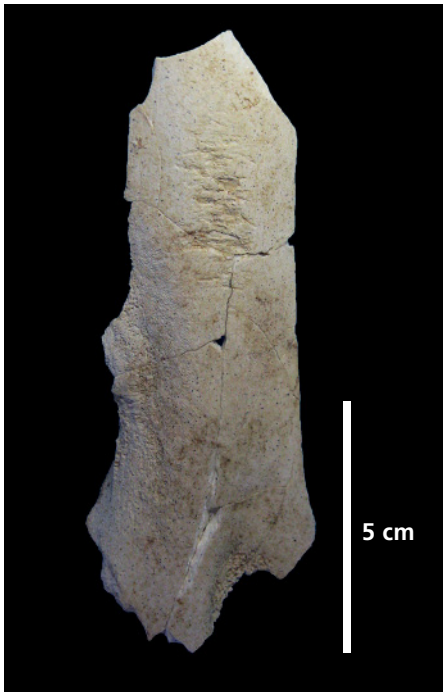

Figure 28 Le Rozel. Red deer right femur (LR 2012, n°175) with a helical fracture, cut marks and one use area; lateral view (photos by Noémie Sévêque).

Figure 29 Le Rozel. Red deer tibia (LR 2012, n°1287) with a helical fracture, impact notch, negative flake scar, cut marks and a use area; cortical, lateral and medullary views (from left to right) (photos by Noémie Sévêque).

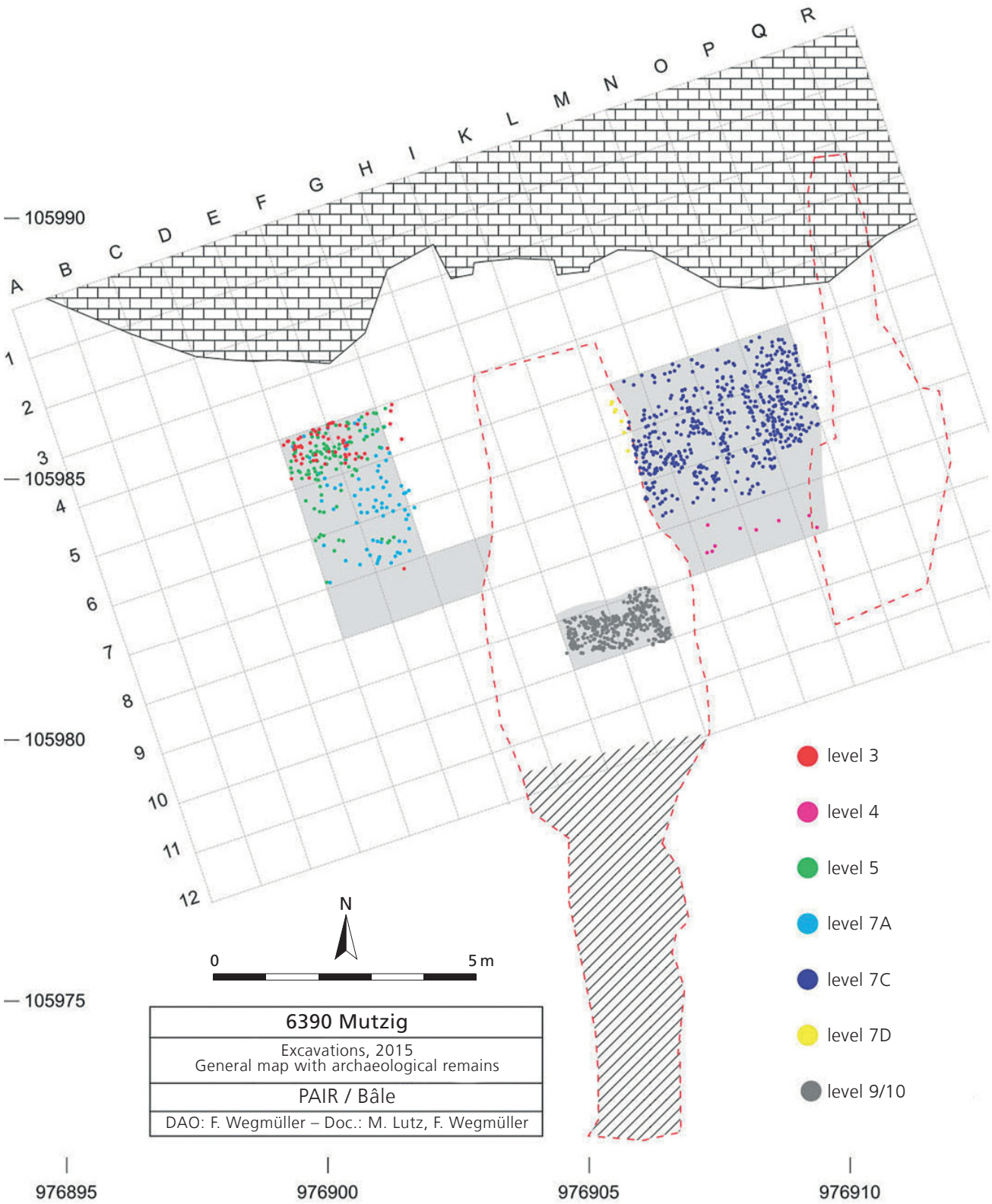

Figure 30 Mutzig. Map of the excavations with horizontal distribution of remains found in 2015 (after Koehler and Wegmüller, 2015).

Table 9 Large fauna species at Mutzig, with MNI (minimum number of individuals).

	Layer							
Taxon	5	7a	7c1	7c2	7d	8	9/10	Total
Rangifer tarandus	2	2	4	7	1	1	7	24
Equus sp.	2	3	4	1		1	1	12
Mammuthus primigenius	1	2	2	1	1	1	1	9
cf. *Bison priscus*	1	1	1	1			1	5
Coelodonta antiquitatis	1	1						2
small bovid			1					1
Canis lupus	2							2
cf. *Alopex lagopus*			1					1
Castor fiber							1	1

Table 10 Seasonality data from each archaeological level at Mutzig.

Level	Age of fawn/foal	Antlers	Months of Occupation	Season of Occupation
5	-	-	-	-
7a	<10 months <20 months	-	Before February	Winter
7c1	12-15 months	-	June - September	Summer
7c2	8-10 months 8-10 months 12-15 months 29-30 months	June – February	February - April February - April June - September November - December	All year
7d	-	-	-	-
8	-	-	-	-
9/10	8-10 months ± 10 months 12-15 months ± 20 months	-	February - April April June - September February	End of Winter - End of Summer

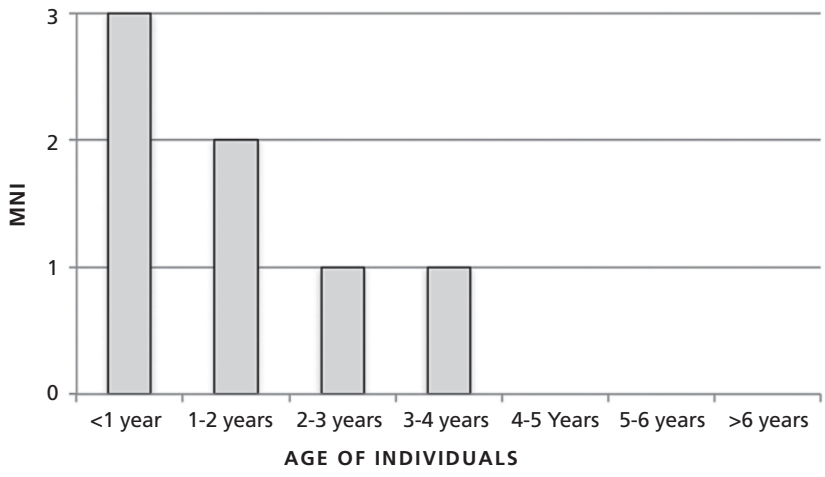

Figure 31 Mutzig. Mortality profile of reindeer in level 9/10.

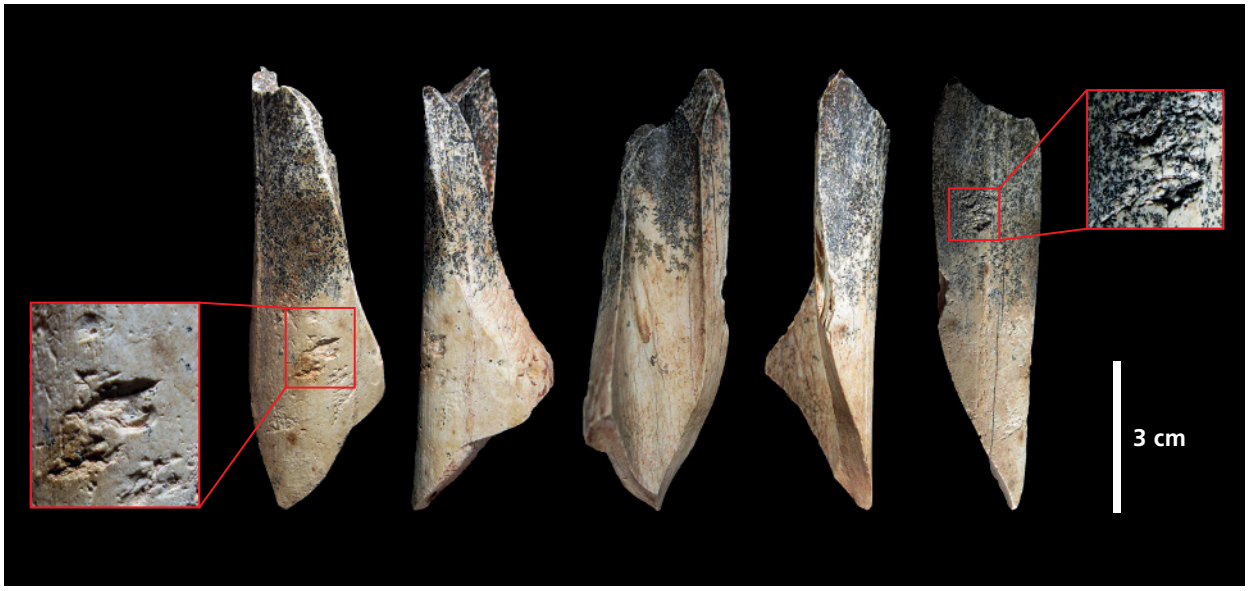

Figure 32 Mutzig. Reindeer right tibia (MII 93, n°11o) with a helical fracture and two use areas; laterocranial, cranial, medullary, caudal-medullary and caudal views (from left to right) (photos by Noémie Sévêque).

The second retoucher was made on the bone of a horse (**Figure 33**), which is the second most represented species. The location of the use area is not clear, since the bone is freshly broken, but the missing portion suggests that the pits and scores were situated more toward the extremity than in the centre of the complete piece. The pits are numerous and rectilinear.

Finally, the third retoucher was made on a reindeer long bone (**Figure 34**). The use area is located in the centre of the artefact, but the bone is also broken so the original shape cannot be determined. The acidic sediment damaged the surfaces of the bone and prevented a detailed characterization of the pits and scores, but some are still visible at the periphery of the use area. The associated surface modifications are also remarkable, with numerous cut marks along one edge of the bone. In fact, this is the only bone from Mutzig that presents so many cut marks. Their location and abundance may suggest that they are not traditional cut marks from butchery activities, but linked to the retouching. Perhaps, Neanderthals tested the sharpness of the lithic tool on the edge of the bone during the retouching activity.

Discussion and conclusion

In northern France, retouchers are known from the end of the Lower Palaeolithic (Cagny-l'Épinette) and were used throughout the entire Middle Palaeolithic (Biache-Saint-Vaast, Le Rozel, Mutzig). Owing to the shape of the use areas and their locations on the bones, it is clear that there is a standardization of these retouchers, established since the beginning of the Middle Palaeolithic. The action of reshaping lithic tools was probably also standardized, whether it be with the large retouchers from Cagny-l'Épinette or the smaller examples from Mutzig. There is no evolution of the retouchers through time, in the same way we see that general patterns in lithic industries and subsistence behaviours did not change substantially during the Middle Palaeolithic. Neanderthals developed a specific tool-kit, and, since the very beginning, all the characteristics typical of Neanderthal culture were present and changed little through time. One problem with Cagny-l'Épinette is that we still do not know which hominin species was present in western Europe at that time *(Homo heidelbergensis* or *Homo neanderthalensis)*. Were the retouchers made by a species other that Neanderthals? If so, we contend that even with only six

retouchers, there was already a standardization of these implements.

There is homogeneity in the source and shape of retouchers in northern France during the end of the Lower Palaeolithic and the Middle Palaeolithic. For the four sites presented here, most retouchers come from long bone diaphyses of herbivores and/or carnivores that were the most abundant species in the assemblages. In general, retoucher size was limited to bone fragments that were easily grasped in the hand.

But at the site level, differences can be seen within the bone tools. Indeed, there are huge differences in the number of retouchers from each site and within different levels of individual sites, from the 303 retouchers in level IIa of Biache-Saint-Vaast to the three retouchers from all levels at Mutzig.

Also, some retouchers show only one use area, while the others present two, three or sometimes four use areas on the same bone. Large concentrations of stigmata and a significant loss of cortical bone material are often described for some retouchers, but others present only a few scores and a very little loss of bone material.

Comparisons with experimental archaeology (Mallye et al., 2012) suggest that the retouchers described here were used in a fresh state, not dry. This corresponds to an *in situ* and *in tempore* use of bone as a raw material, where the elastic property of fresh bone is important.

Another noteworthy difference is the association with scraping marks, which may provide clues as to the timing of use. Experiments also show that scraping can be, if not should be, made on bones to remove the periosteum. This prepares the surface for percussion and then for the extraction of marrow or for use as a bone tool (Valensi, 2002). Some retouchers studied here present scraping marks on their surface, but others do not. Scraping seems to be habitual at Biache-Saint-Vaast and cleverly planned at Le Rozel, occurring only on retouchers with several use areas.

It is important to ask: what are the factors that can cause the differences mentioned above? First, the lithic raw material does not seem to have had much of an influence over the retouchers from northern France. Only flint was used at Cagny-l'Épinette and Biache-Saint-Vaast, yet the number of retouchers at

Figure 33 Mutzig. Horse long bone (MVIII 94, S8, n°2) with one use area; cortical (left) and medullary (right) views (photos by Noémie Sévêque).

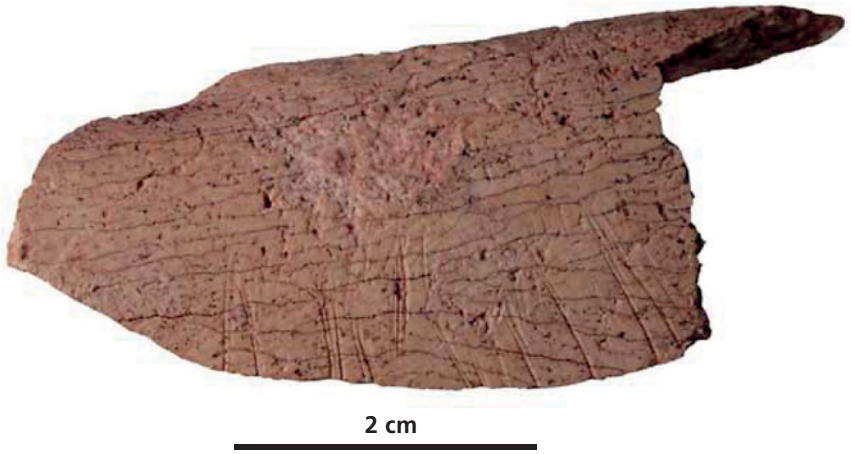

Figure 34 Mutzig. Reindeer long bone (M2 2013, c5, O6, n°171) with cut marks and one use area; cortical view (photo by I. Déchanez-Clerc).

these two sites is widely different. At Le Rozel, flint was used along with quartz and sandstone, and 38 retouchers have been identified in only four years of excavations. Finally, flint is rare in eastern France; at Mutzig, Neanderthals used at least 15 different lithic raw materials. Flint is absent in layers 7c1 and 9 at Mutzig and is most abundant in layer 7a, yet still accounts for only 18.2% of the material (Koehler and Wegmüller, 2015). Despite this, retouchers have been identified and were used regardless the lithic raw material.

The lithic tools associated with the retouchers are also an important consideration. The balance between the number of retouchers and flake tools is not the same across the four sites. Depending on the level, the flake tools of Cagny-l'Épinette represent 10-20% of the lithic assemblage (Moigne et al., 2016). This is quite a high for only six retouchers in the entire assemblage. On the contrary, Biache-Saint-Vaast level IIa yielded 303 retouchers and only 449 retouched artefacts (Auguste, 2002). In all levels combined, 483 flake-tools (1% of the lithic material) were discovered for 333 retouchers (Hérisson, 2012). The pattern at Le Rozel is the same as Biache-Saint-Vaast: 23 scrapers account for all of the flake tools (less than 1% of the lithic material), whereas 38 retouchers have been identified. Finally, the ratio of flake-tools from the new excavations at Mutzig is quite low: 28 retouched artefacts, representing only 6.9% of the lithic assemblage (Koehler et al., 2016), compared to only one retoucher (the two other retouchers came from the historic excavations). Overall, the ratios of retouchers to flake tools is quite variable – there are actually more bone retouchers than flake tools at Le Rozel. The types of tools also do not seem to be a factor, since several different tools were produced at the sites: three tool types at Cagny-l'Épinette, seven types at Biache-Saint-Vaast and four at Mutzig. The exception is Le Rozel, where only scrapers are present.

Site function may play a role in the identification of bone retouchers, since different types of sites preserve the remains of different activities. Cagny-l'Épinette and Biache-Saint-Vaast were both likely kill and butchery sites. The site functions were the same, but the number of retouchers is very different. Biache-Saint-Vaast is a large site with many occupations and the remains of a total of 626 individual animals. Cagny-l'Épinette preserves the remains of 123 animal individuals but only three retouchers. Between these two sites, the numbers of retouchers is not proportional to the number of animals killed. Le Rozel and Mutzig are butchery locations and communal habitation places. At Le Rozel, the 38 retouchers exceed the 21 animal individuals counted. But for Mutzig, there is a noteworthy discrepancy between the 30 animal individuals and the single retoucher found during the modern excavation. For

now, we do not ascribe any connection between the function of the site and the number of retouchers, since for these four sites, the ratios between the number of animals killed and the number of retouchers is completely random.

In some cases, spatial distributions can provide evidence of activity areas with clearly delineated concentrations of butchery and/or knapping debris. In the future, it would be worthwhile to visualise the spatial arrangements of these retouchers in order to determine if they are clearly related to activity areas or randomly distributed across the sites.

A number of studies about bone tools from northern France are still in progress. We hope that future excavations at Le Rozel and Mutzig will provide more retouchers to further examine the use of these tools at the site level and across the broader region of northern France.

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