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L'acquisition et le traitement des matières végétales et animales par les néandertaliens : quelles modalités et quelles stratégies ?

Analysis of the faunal remains: results

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CHAPTER 3

Analysis of the faunal remains: results

(S. Costamagno)

As discussed in the first chapter, analyzing the butchery marks using the reference collection produced during the research project was only possible for a limited number of sites. Aside the open-air sites that did not contain bone remains, the stratigraphic issues involved in some sequences (Abri Olha) and the poor preservation of the bone surfaces in some assemblages (Mauran, Coudoulous 1, Les Fieux) rendered this type of approach impossible. Furthermore, some sites could not be re-evaluated, as the zooarchaeologists involved in the research project were not part of the scientific teams (Chez-Pinaud, Payre, Saint-Césaire). Out of the whole corpus, only two sites could be studied: Les Pradelles and Grotte du Noisetier. Due to the limited number of sites, we have chosen to present the results per site. At Les Pradelles, only the butchery marks were analyzed, whereas at Grotte du Noisetier all three approaches were used (Lemur, 2016; Val *et al.*, 2017), but the small size of the sample did not allow us to make use of the data for quantifying the marks. In the discussion section, we have extended the comparisons by taking into account the zooarchaeological studies available (Moncel *et al.*, 2002; Coumont, 2006; Rivals *et al.*, 2009; Morin, 2012; Gerbe *et al.*, 2014).

1 - Interpreting the butchery marks: facies 4a of Les Pradelles (Marillac-le-Franc, Charente) attributed to the Quina Mousterian

(M.-C. Soulier)

The reference collection for the butchery marks, which was established by incorporating the results of the experiments carried out under the research project “*Des Traces et des Hommes*” with that of the other existing butchery reference collections (Soulier, Costamagno, 2017; Part I, chapter 3.3), was applied to the reindeer bone remains from facies 4a of the Mousterian site of Les Pradelles (Marillac-le-Franc, Charente).

A - Corpus and methodology

Each bone fragment that could be identified, lateralized, and precisely replaced was observed using a $\times 30$ using a magnifying lens and recorded on bone templates in Adobe Illustrator®. To ensure the results were as accurate as possible, the templates were scaled 1:1 in relation to a complete bone and we took into account the maximum number of anatomical reference points. The outline of each fragment was drawn, even if it was devoid of any marks (as recommended by Castel, 2005), to allow the different archaeological assemblages to be compared (e.g. repeatedly marked areas in different assemblages with the exception of just one) and to avoid any misleading interpretations solely due to problems of differential determination. To analyse the data, the pieces were all transposed on the right-hand side. The superposition of the fragments allowed us to quickly and accurately calculate the Minimum Number of Elements (MNE) and the Minimum Number of Individuals by frequency (MNIf).

The analysis of butchery marks focused on the skeletal elements of the hind legs (femur, patella, tibia, tarsal block, metatarsal, and phalanges) of reindeer and concerned only the remains collected during the “Maureille & Mann” excavations for facies 4a (figure 189). Facies 4a is the layer that

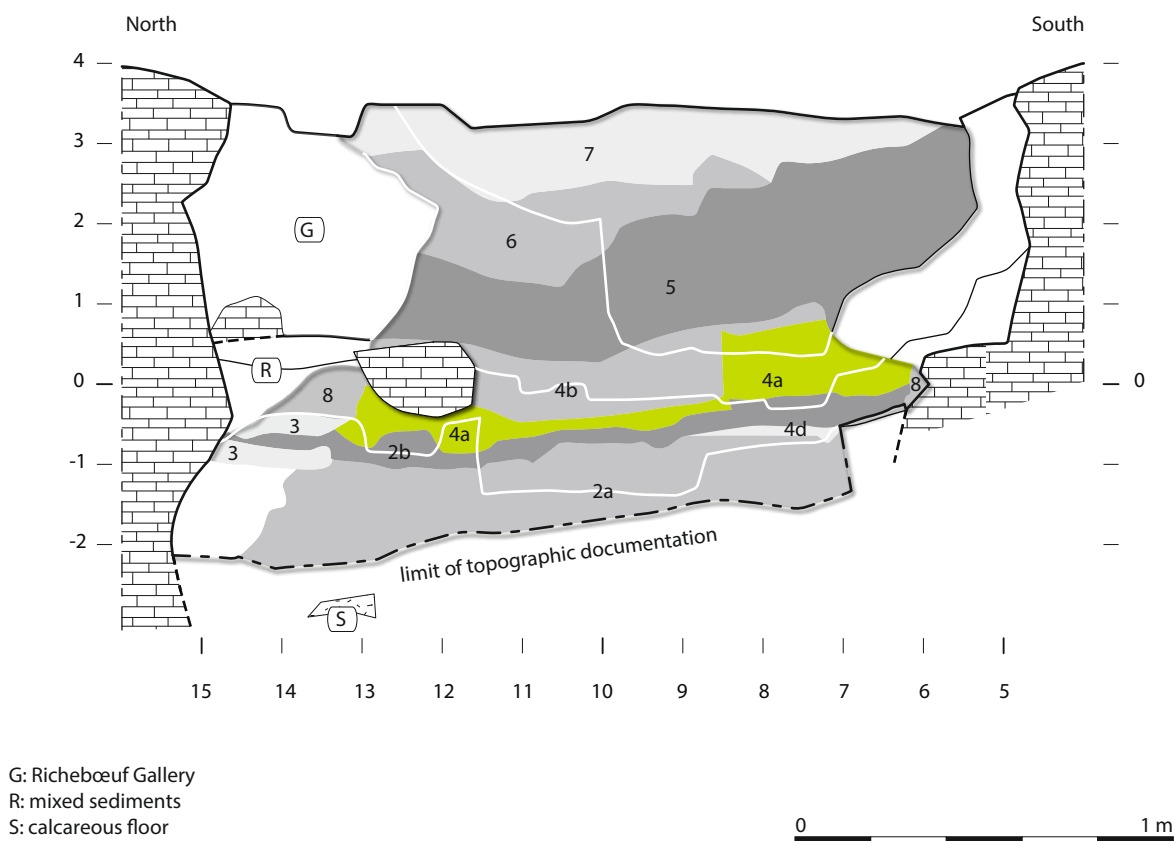


Figure 189 - The site of Les Pradelles: frontal cross-section (facies 4a is shown in green, modified from Maureille *et al.*, 2010).

is most marked by human activity (Maureille *et al.*, 2010b). Reindeer is the dominant species, representing 98.4 % of the faunal spectra, with large bovids and horse being the only two other ungulates identified in this assemblage (Costamagno *et al.*, 2017). The bones are very well preserved, with few carnivore marks, and show numerous cutmarks and marrow cracking evidence. For Facies 4a, 1394 faunal remains were recorded (figure 190). By recording each bone fragment, it was possible to establish the presence of at least 58 different reindeer (based on the right femur). The articular extremities were much less common than the diaphysis fragments.

B - Analysis of the cutmarks: results

Cutmarks were present on 71.9 % of the 1394 fragments recorded. The lowest frequencies of cutmarks were observed on the bones of the acropodium; no cutmarks were observed on the distal phalanges.

a - Skinning

Cutmarks produced during skinning were observed on the tibia, metatarsal, and proximal phalanges (figure 191).

Most of the cutmarks related to this butchery step were found on the metatarsal (figure 191^a). Three types of cutmark were observed: cutmarks created during initial circular incision (*Mts-a''*: in violet), cutmarks produced during longitudinal incision (*Mts-a'*, *Mts-b'*: in orange), and cutmarks produced by the oblique gestures carried out to lift the skin after making the incisions (*Mtp-d*, *Mts-a*, *Mts-b*: in grey). Oblique cutmarks were also documented in the *Mts-d* zone. The circular

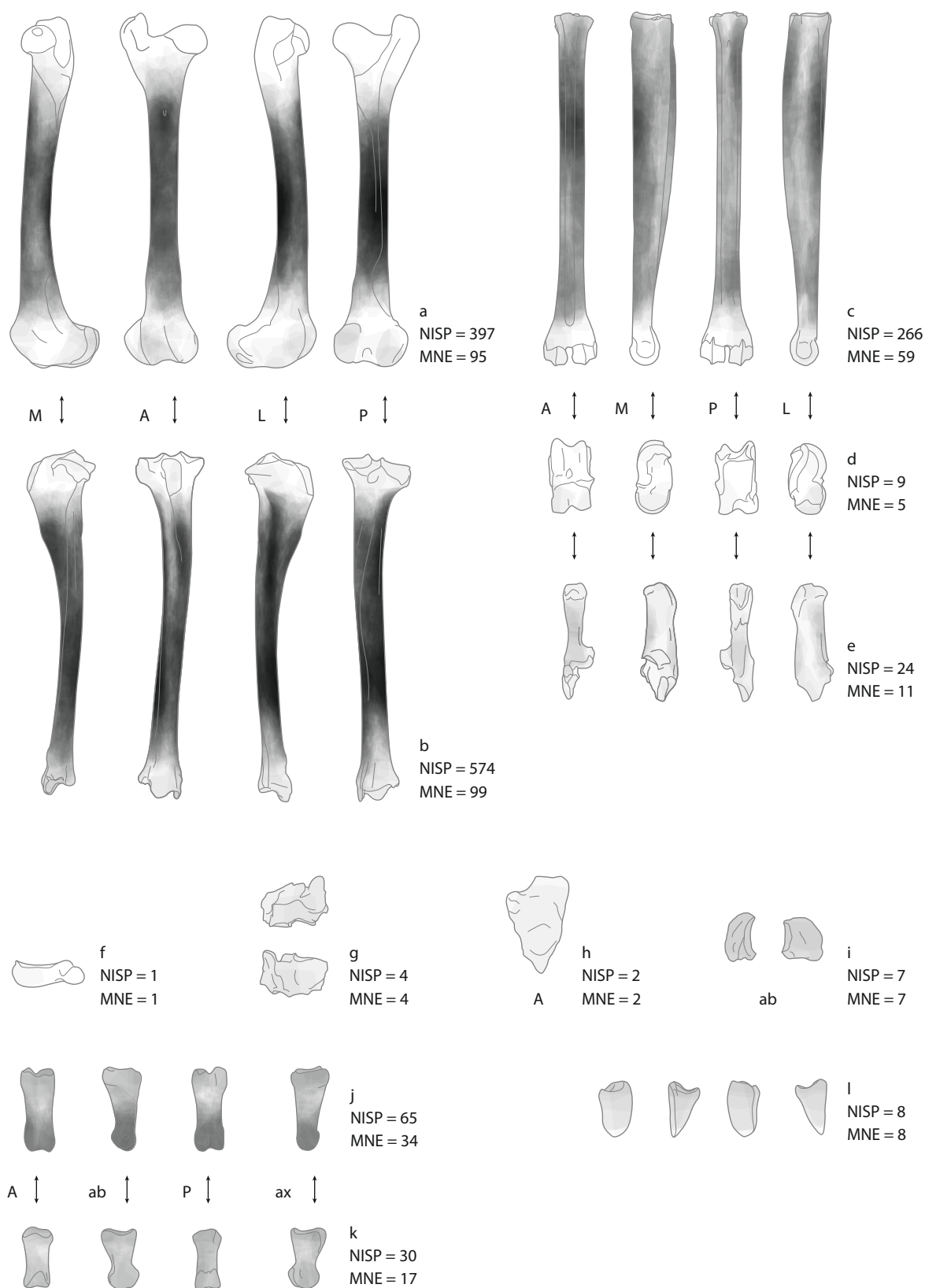


Figure 190 - Summary of reindeer bone fragments identified in layer 4a, Number of Remains drawn (NISP) and Minimum Number of Skeletal Elements (MNE) for a: the femur; b: the tibia; c: the metatarsal; d: the talus; e: the calcaneus; f: the first cuneiform; g: the cubo-navicular; h: the patella; i: the sesamoids; j: the proximal phalanges; k: the mesial phalanges; l: the distal phalanges. Abbreviations: A = anterior, M.= medial, P = posterior, L = lateral, ab = abaxial, ax = axial (CAD: M.-C. Soulier).

incision marks were present over the entire length of the diaphysis, without any preferential zone being identified. The longitudinal incisions were made on both the lateral and medial faces. A few short, transverse cutmarks were also observed on the distal tibia (*Td-c*: figure 191^b) and on the proximal phalanges (*Ph1-e*, *Ph1-f*: figure 191^c), indicating that the initial circular incision was sometimes made on the distal part of the zeugopodium and the acropodium.

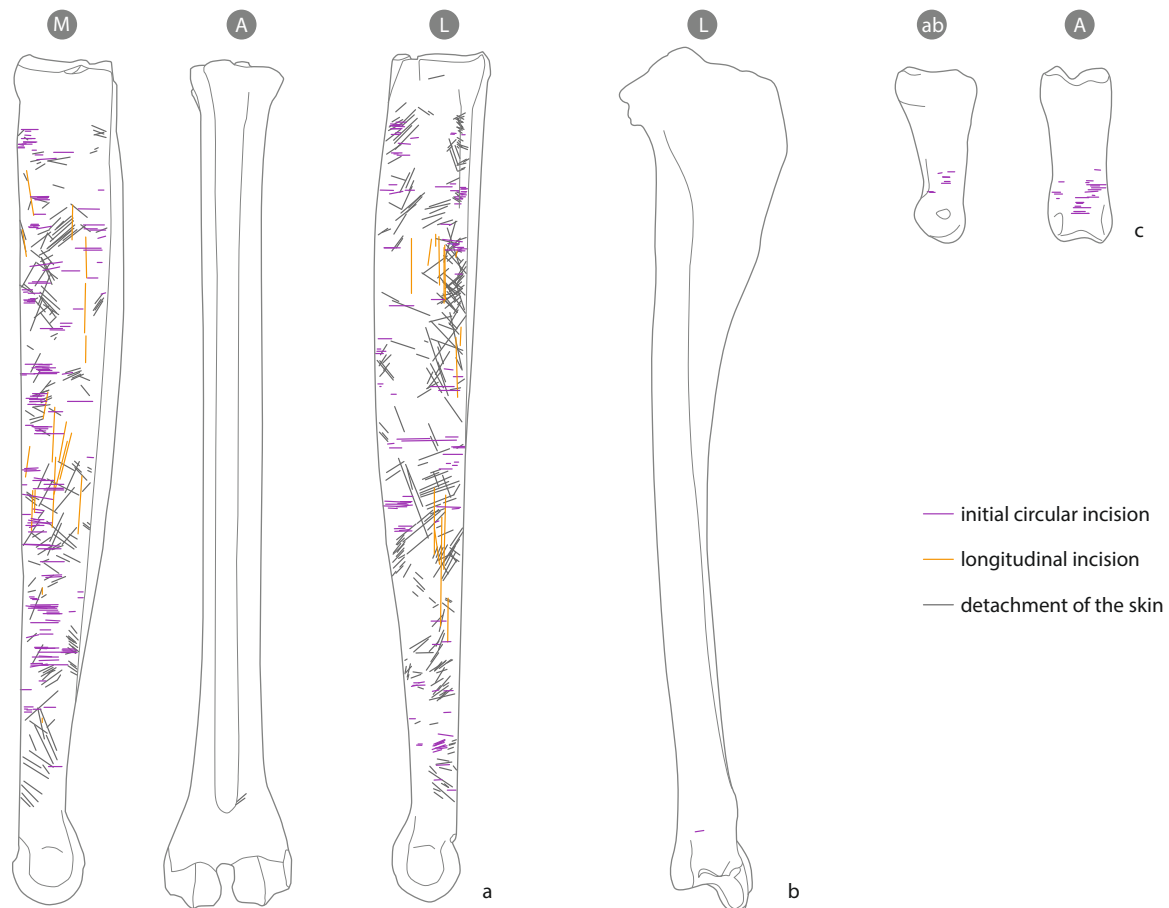


Figure 191 - Cutmarks from skinning observed on a: the metatarsal; b: the tibia; c: the phalanges. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, L = lateral, ab = abaxial (CAD: M.-C. Soulier).

b - Defleshing

Amongst the skeletal elements analyzed, defleshing marks were observed on all the bones potentially affected by this activity (figures 192-193). The defleshing marks were abundant and were found on 314 of the 397 femur fragments drawn as located between parts 2 to 5 (the most likely parts to present defleshing marks: Soulier, Costamagno, 2017), and on 359 of the 549 tibia fragments, i.e. 69.3 % of the diaphysis fragments of the fleshy long bones that were drawn.

These defleshing marks were mostly oblique and transverse and were distributed over the entire length of the femur and tibia diaphysis. For these two skeletal elements, we also noted the presence of numerous longitudinal cutmarks (figures 192-193^a). Oblique defleshing marks were also observed on an almost complete patella (*Pat-a*: figure 193^b) and on the calcaneus (figure 193^c). On this latter element, we also noted the presence of transverse cutmarks and a longitudinal cutmark in zone *Cal-d'*.

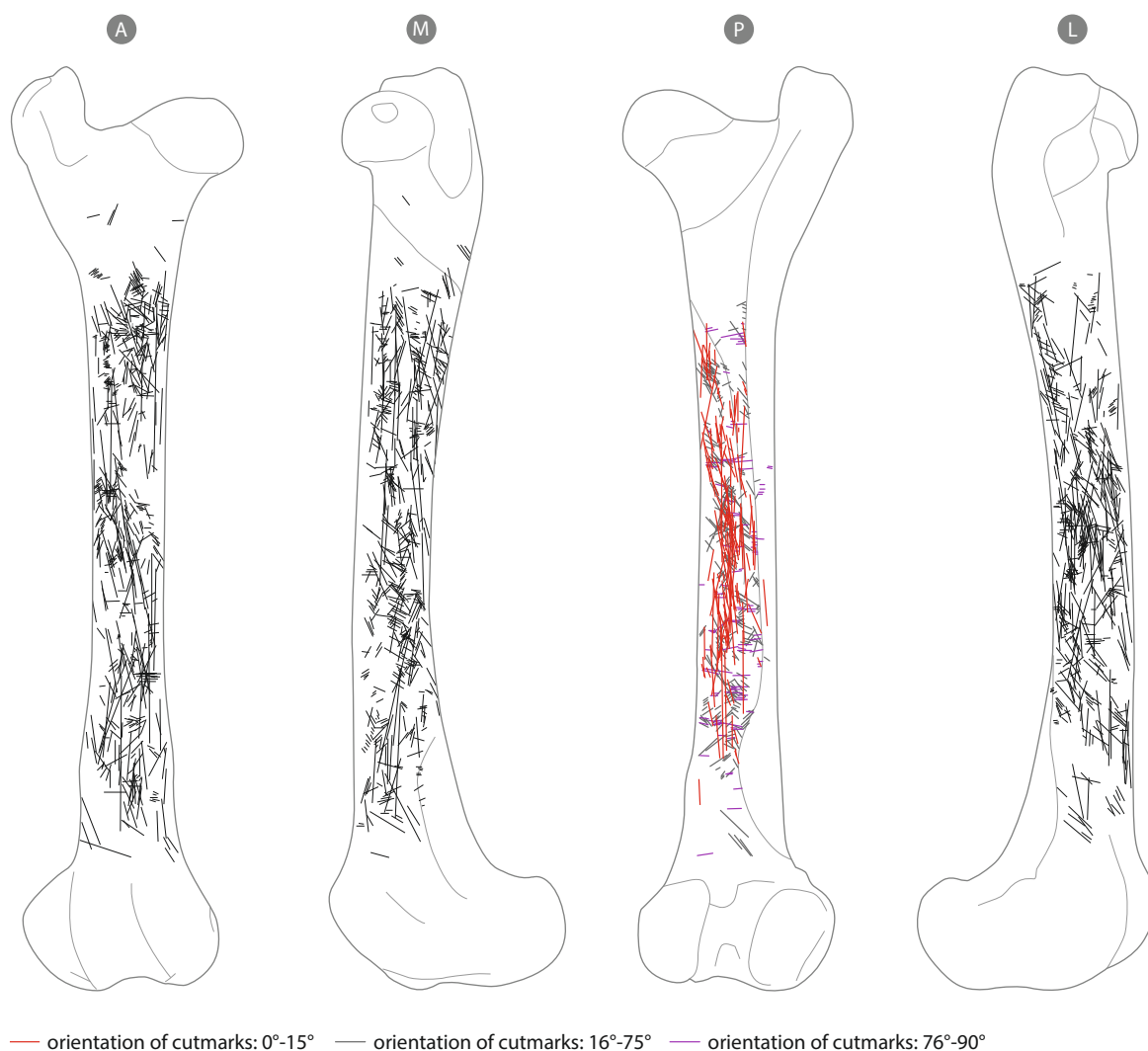


Figure 192 - Cutmarks from defleshing observed on the femur. The cutmarks present on the posterior surface of the femur have been coloured according to their orientation (according to the categories proposed by Soulier and Morin 2016). The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: M.-C. Soulier and M. Coutureau).

c - Disarticulation

Few disarticulation marks were observed on the long bones, which may be largely due to the low occurrence of articular extremities (see [figure 190](#)). Indeed, only 101 (n=26 for the femur, n=25 for the tibia, and n=50 for the metatarsal) of the 1 237 long bone fragments drawn were parts likely to have been marked by disarticulation (parts 1 and 6: see Soulier, Costamagno, 2017; Part II, chapter 3.3).

The presence of a few *Fd-g* cutmarks on a distal femur fragment indicates disarticulation between the stylopodium and the zeugopodium ([figure 194^a](#)); no disarticulation marks were observed on the few proximal tibia fragments, however. The disarticulation of the tibia and the tarsal block was evidenced by the presence of localized transverse cutmarks ([figure 194^b](#)) at the malleolar joint (*Td-e*) and just above the distal joint on the anterior surface (*Td-f*[°]). The malleolus also presented disarticulation marks (*Ml-a*: [figure 194^c](#)). Deep, localized cutmarks on the tarsal bones indicate the disarticulation of the ankle ([figure 194^d](#)). These cutmarks were present on three calcanei (*Cal-c*, *Cal-e*, *Cal-e*[°]), four cubo-navicular bones (*Cbn-a*), three talus bones (*Tal-a*, *Tal-b*, *Tal-d*), and



Figure 193 - Cutmarks from defleshing observed on a: the tibia; b: the patella; c: the calcaneus. The cutmarks present on the posterior surface of the tibia have been coloured according to their orientation (according to the categories proposed by Soulier and Morin 2016). The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: M.-C. Soulier and M. Coutureau).

a large cuneiform (*Gcf-a*). The orientation and location of the marks indicate that disarticulation was carried out here without preference as to whether the leg was held bent (*Tal-a*, *Cal-e*) or extended (*Tal-b*, *Cal-e*). It also implies that the point of disarticulation varied from the distal part of the tibia, to the contact zone between the large cuneiform and the talus, and the proximal part of the metatarsal. This disarticulation also left transverse marks near the proximal articular extremity, on the lateral, medial (*Mtp-a*) and anterior (*Mtp-b*) faces of the metatarsal (figure 194^c). A distal metatarsal fragment presented oblique marks (*Mtd-a*) indicating the separation of the metatarsal from the first phalanges. This operation also left traces on the proximal joint of the first phalanges (*Ph1-a*: figure 194^e) and on the sesamoids (*Ses-d*, *Ses-h*: figure 194^h). The proximal and mesial phalanges had, in some cases at least, been disarticulated from each other as demonstrated by some oblique and sub-transverse cutmarks located near the proximal articular surface of the mesial phalanges (figure 194^f), in areas *Ph2-b*, *Ph2-d*.

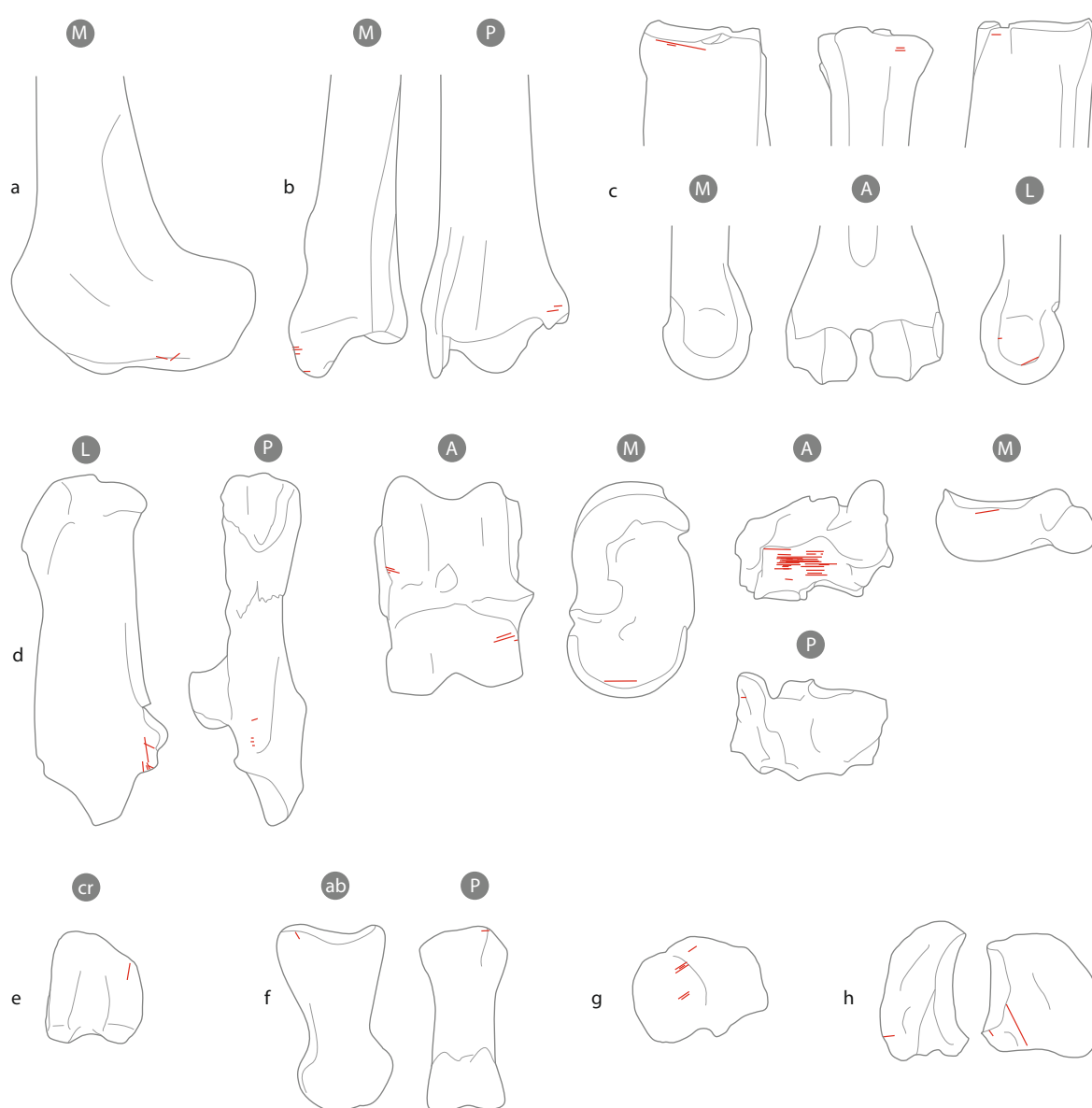


Figure 194 - Cutmarks from disarticulation observed on a: the femur; b: the tibia; c: the metatarsal; d: tarsal bones; e: proximal articulation of the first phalanx; f: the middle phalanges; g: the malleolus; h: the sesamoids. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral, ab = abaxial, ax = axial, cr = cranial (CAD: M.-C. Soulier and M. Coutureau).

d - Tendon removal

Many of the metatarsal fragments presented cutmarks produced during tendon removal (figure 195^a). (Sub-)transverse or oblique cutmarks, located in the anterior (*Mtp-c*, *Mts-c*) and posterior (*Mtp-e*, *Mts-f*) gutters, indicate the severing of the flexor and extensor tendons (in blue). These cutmarks were distributed over the entire diaphysis, but there appeared to be a certain recurrence on the distal part of the posterior surface. Some long cutmarks (shown in red) indicate the passage of the tip of a lithic tool in a longitudinal gesture in the gutter to detach the tendon from the bone; these longitudinal marks were located on both the anterior (*Mts-c*) and posterior (*Mts-f*) faces. For the acropodium (figure 195^b), oblique cutmarks made by the severing of the tendons were observed on the anterior (*Ph1-f*) and posterior (*Ph1-h*) faces of the proximal phalanges. Although *Ph1-h* cutmarks can be made during skinning in the case of butchery carried out with metal tools, those observed at Les Pradelles most likely result from the severing of the tendons.

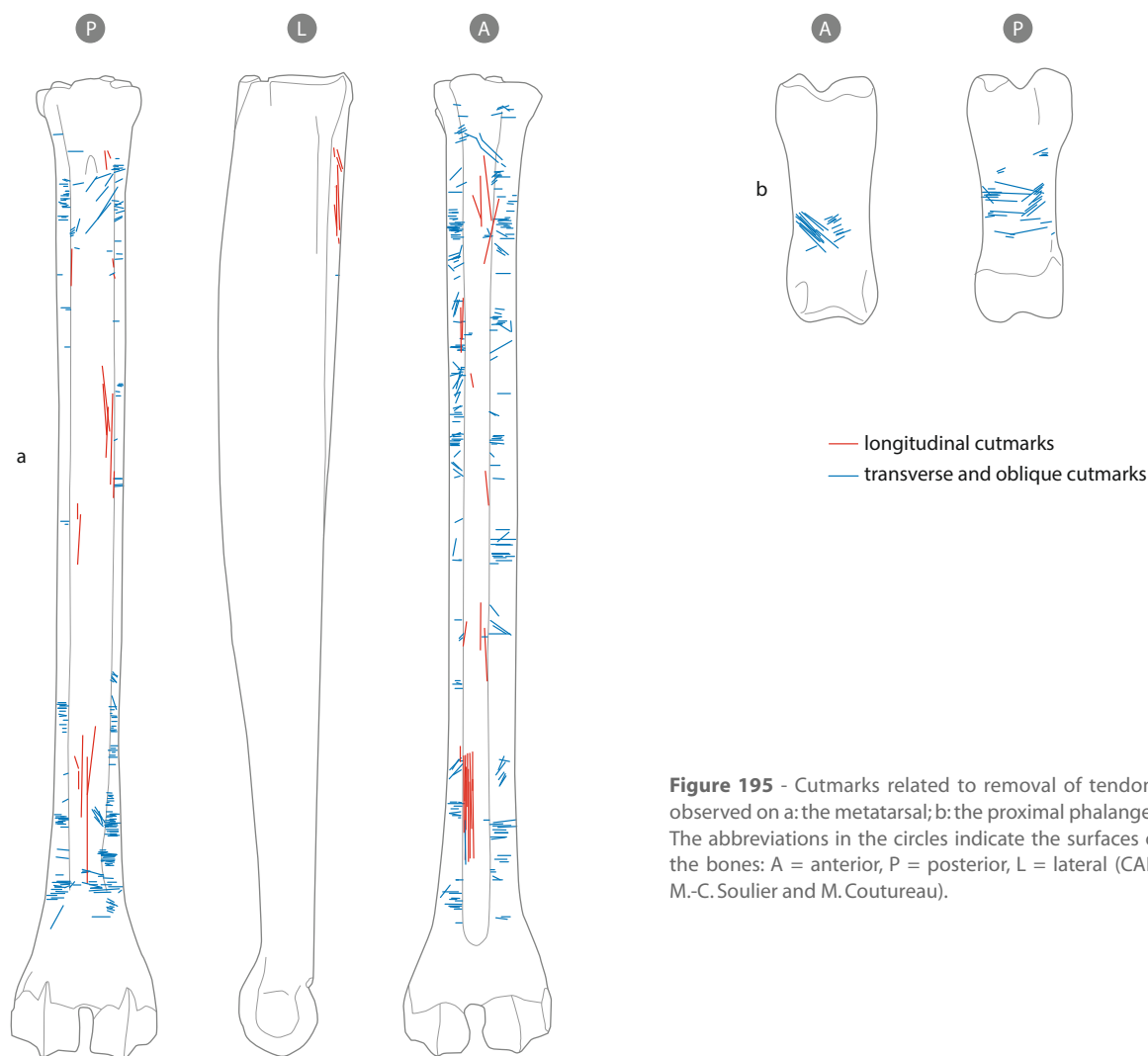


Figure 195 - Cutmarks related to removal of tendons observed on a: the metatarsal; b: the proximal phalanges. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, P = posterior, L = lateral (CAD: M.-C. Soulier and M. Coutureau).

e - Ambiguous cutmarks

Cutmarks for which the orientation and location did not allow a correlation with a specific activity were also observed.

Cutmarks that could either result from defleshing or disarticulation were observed on the distal femur (oblique *Fd-b* cutmarks on the lips of the trochlea: [figure 196^a](#)) and on the mesial part of the anterior face of the calcaneus (*Cal-a*: [figure 196^b](#)).

Many of the cutmarks observed on the tibia were problematic as the skin is in direct contact with the bone over more than half of the distal part of the medial surface, and defleshing can also produce cutmarks in this area. The problematic cutmarks in question were the numerous longitudinal marks observed on the medial faces and the transverse marks on the distal portions and on all the faces of the diaphyses ([figure 196^c](#)). These cutmarks could all have resulted from defleshing, but they could also have been produced by circular incisions made on the distal part of the zeugopodium (*Td-d''*, *Td-b''*, *Ts-e''*) or longitudinal incisions made on the medial surface of the limbs (*Ts-b'*, *Ts-d'*) during skinning.

Ambiguous cutmarks were also observed on the anterior and abaxial faces of the proximal phalanges ([figure 196^d](#)). These cutmarks, which were located in the *Ph1-c* zone, were (sub)transverse and could just as well result from the disarticulation of the metapodials and the acropodium as from the circular incision of the skin.

f - Cutmarks not described in the reference collections

Amongst the cutmarks observed in Facies 4a, some marks located on the femur, patella, tibia, calcaneus, metatarsal, phalanges, and sesamoids were not documented in the butchery reference collections ([figure 197](#)). Although it is only possible to interpret these cutmarks relatively accurately using the current reference collections, the location of certain cutmarks allowed us to envisage some lines of interpretation.

On the femur, some longitudinal cutmarks were present ([figure 197^a](#)) in the *Fd-a* zone, on the anterior surface of the distal diaphysis, areas where only transverse or oblique cutmarks have hitherto been observed. Given their orientation and location, these cutmarks were probably made by defleshing activities, like the *Fs-a'* cutmarks located just above. Still on the distal femur, but on the medial surface, longitudinal cutmarks were observed in the *Fd-b* zone. To date, only oblique and transverse cutmarks have been documented in this area. A comparison of the different butchery reference collections showed that this zone could be affected by both defleshing and disarticulation activities. The longitudinal orientation of the cutmarks observed in Facies 4a tends to suggest defleshing, but this interpretation must be qualified, because longitudinal cutmarks can also be produced during disarticulation, depending on the way the leg is held (bent or extended, i.e. *Cal-e*/*Cal-e'*).

On the patella, oblique cutmarks were observed below the *Pat-a* zone ([figure 197^b](#)), where the vastus muscles attach. Given the strong similarity between these cutmarks, those obtained during the experiments carried out under the research project, and the other cutmarks observed on the patella in Facies 4a (see [figure 193^b](#)), these marks could have been produced by defleshing.

On the distal tibia, oblique cutmarks were observed in the *Td-a* and *Td-c* zones ([figure 197^c](#)) whereas only transverse and/or longitudinal cutmarks have been documented in the different existing butchery reference collections for these two zones. Given that in both zones, the cutmarks documented in the reference collections were only produced during skinning, the oblique cutmarks observed on the medial and lateral faces of Facies 4a may in all likelihood have resulted from this activity. This hypothesis is supported by the fact that the cutmark located on the medial surface was observed on the same fragment as that bearing the transverse cutmark shown in [figure 191^b](#).

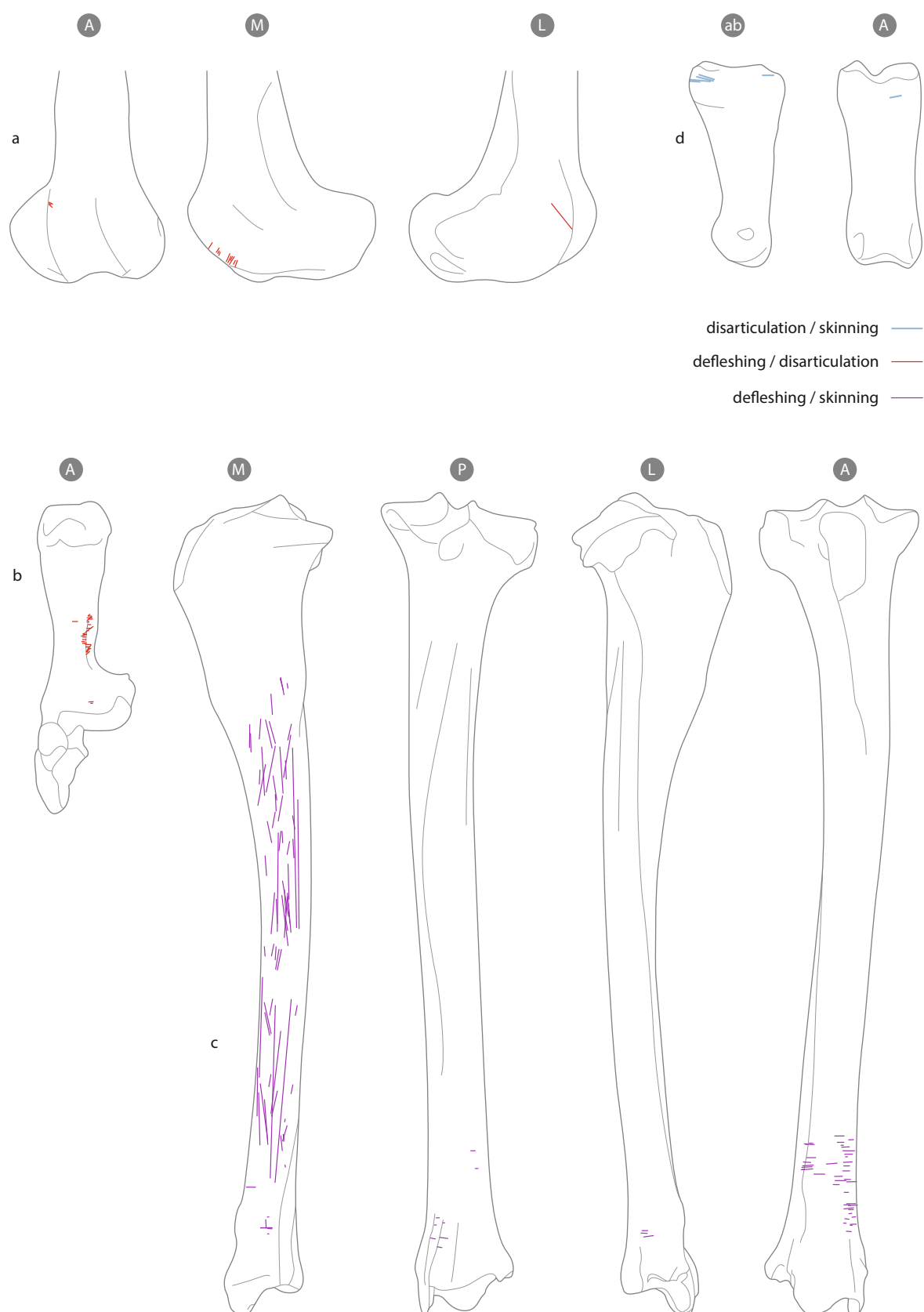


Figure 196 - Ambiguous cutmarks observed on a: the femur; b: the calcaneus; c: the tibia; d: the proximal phalanges. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral, ab = abaxial (CAD: M.-C. Soulier and M. Coutureau).

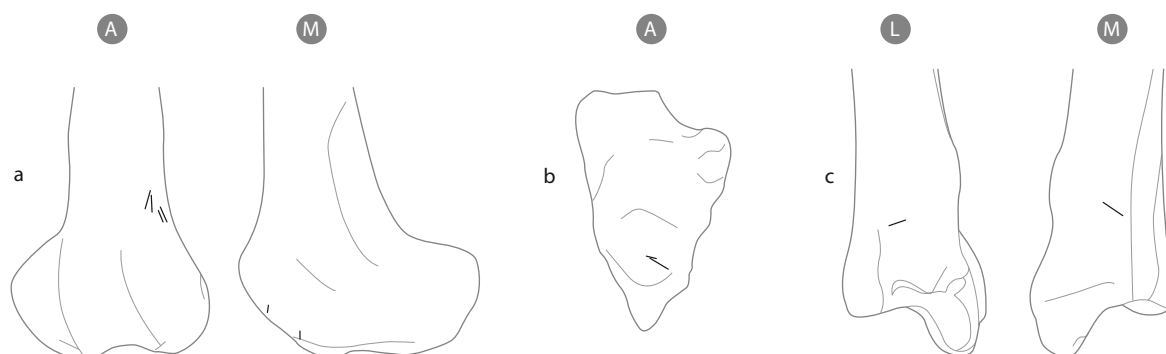


Figure 197 - Cutmarks not described in available references on a: the femur; b: the patella; c: the tibia. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, L = lateral (CAD: M.-C. Soulier and M. Coutureau).

On the calcaneus, numerous cutmarks not documented in the reference collections were observed on the posterior, lateral and medial faces ([figure 198^a](#)). As this element could potentially be affected by disarticulation, defleshing, or skinning, it is difficult to interpret these cutmarks. For the lateral surface, it should be noted that the cutmarks observed in the middle of the bone (shown in blue) were located near the *Cal-i* zone, an area in which all the cutmarks documented in the reference collections result from defleshing activities. The oblique cutmarks situated on the distal part of this same surface (shown in red) are in continuity with the cutmarks produced by the research project during defleshing activities. On the posterior surface, a cutmark is located just above the *Cal-c* zone (shown in red) and could have been produced by the disarticulation of the knee. The activities that produced the other cutmarks are currently difficult to establish.

Many unidentified cutmarks have also been observed on the proximal and distal parts of the metatarsal ([figure 198^b](#)). On the posterior surface, the cutmarks observed on the proximal and distal parts, illustrated in yellow, could, as with the *Mts-f* cutmarks, have been made by the severing of the flexor tendon. On the proximal part of the anterior surface, there is a longitudinal cutmark in the *Mtp-c* zone (in yellow), an area where only transverse cutmarks have been documented; as with the cutmarks obtained during the experiments conducted under the research project on the metacarpal, or lower down on the posterior surface of the metatarsal, this cutmark could have been made by the tip of a tool passing through the gutter to detach the extensor tendon. The transverse cutmarks located in the gutter (in yellow) are too far from the joint to have involved the disarticulation of the tarsometatarsal joint and are more likely to have been produced during the severing of the tendon. Transverse, grouped cutmarks (shown in green), similar to those produced during the circular incision of the skin (i.e. *Mts-b''* and *Mts-a''*) were observed on the proximal part of the medial and lateral faces. On the distal part of the lateral surface, an oblique cutmark was found in continuity with the *Mtd-a* cutmarks (shown in red), and could have been produced during the disarticulation of the metatarsal and the proximal phalanges (an activity documented by other cutmarks, see [figure 194^c](#)).

In Facies 4a of Les Pradelles, numerous cutmarks were observed on the first and second phalanges which were not described in the reference collections ([figure 198^d](#)). On the posterior surface, predominantly (sub-)transverse cutmarks were documented on either side of the *Ph1-h* and *Ph2-h* zones, areas where the bone is protected by a thick tendon; it is therefore highly likely that these marks were produced during the severing of the digital flexor tendon. On the anterior surface, the numerous oblique and longitudinal cutmarks observed on the first phalanx, above the *Ph1-f* zone, could also be related to tendon removal. On the abaxial surface, numerous transverse and longitudinal cutmarks were documented above the *Ph1-e* zone, an area for which all the cutmarks recorded

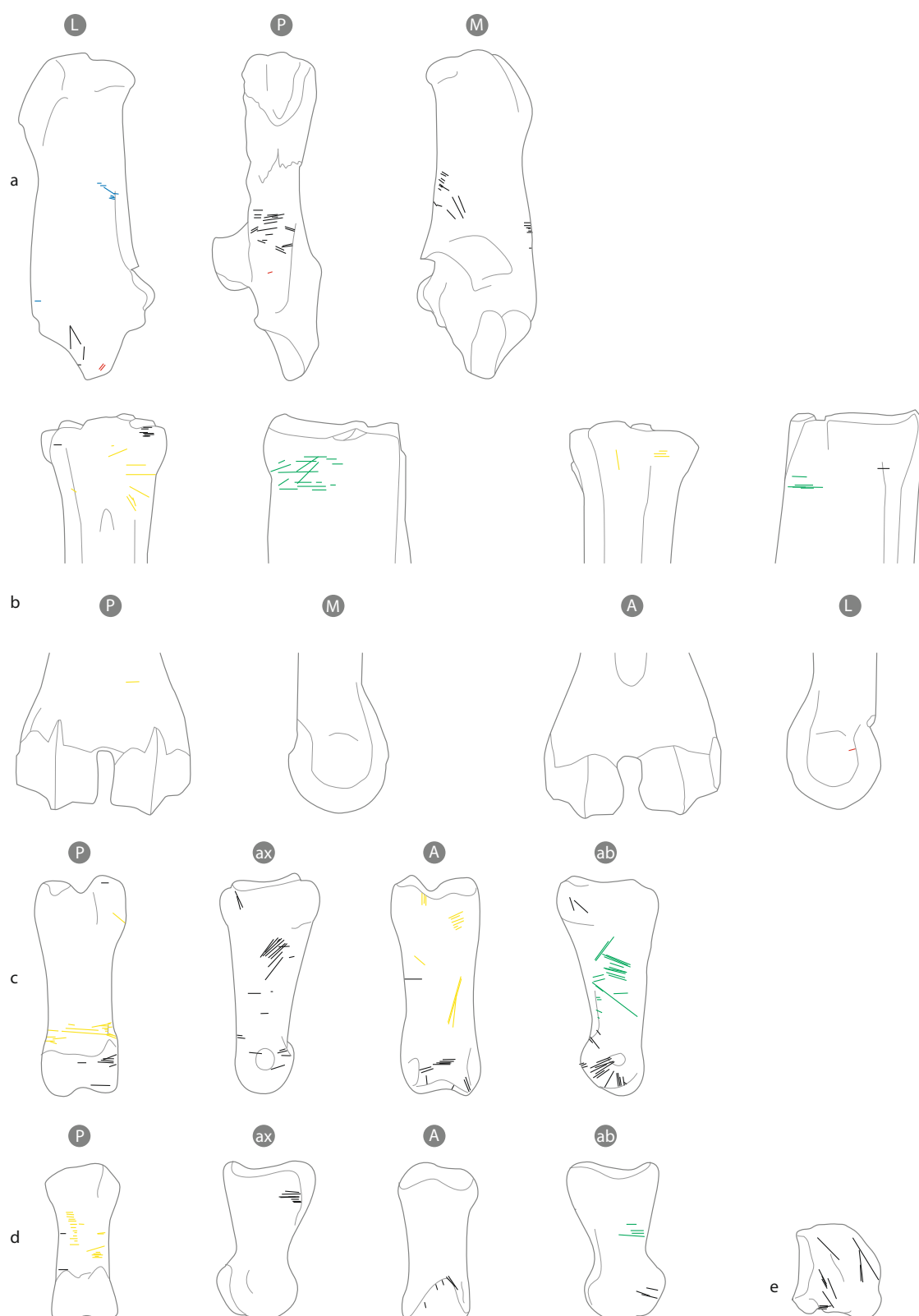


Figure 198 - Cutmarks not described in the reference collections observed on a: the calcaneus; b: the metatarsal; c: the proximal phalanges; d: the mesial phalanges; e: the sesamoids. Tentative interpretations are offered in the text for the cutmarks presented in colour; in blue: cutmarks that may have been produced by defleshing, in red: cutmarks that may have been produced by disarticulation, in yellow: cutmarks that may have been produced during removal of the tendons, in green: cutmarks that may have been produced during removal of the hide. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral, ab = abaxial, ax = axial (CAD: M.-C. Soulier and M. Coutureau).

in the T&H reference collection were produced during skinning. The transverse cutmarks documented in Facies 4a generally involved groups of cutmarks, which may correspond to the circular incision zones. Surprisingly, a relatively large number of cutmarks were also observed on the axial surface of the first and second phalanges; the nature of these marks remains to be determined, but we can already exclude the possibility that they were generated by skinning and assume that the digits were disarticulated from each other. On all the faces, cutmarks were observed on, or in the immediate vicinity of, the joints; the meaning of these marks remains unclear (Tendon removal? Disarticulation? Skinning?) because no cutmarks of this type have thus far been documented in the reference collections. Finally, oblique cutmarks were observed in the *Ph1-g* zone on the distal part of the abaxial surface of the first phalanx, an area where only longitudinal cutmarks – related to tendon removal – have hitherto been observed.

The external sesamoid (figure 198°) presented numerous, essentially oblique, cutmarks which were not obtained during the experiments carried out as part of the T&H research project nor described in any other reference collections. The cutmarks documented on this skeletal element were all related to the severing of the tendons and disarticulation, but nothing allows us to go into more detail on the type of activity that generated these marks.

Given the numerous zones with ambiguous cutmarks identified by the experiments of the T&H research project, and in light of the comparisons made between the different existing butchery reference collections (Soulie, Costamagno, 2017), it is clear that these attempts at interpretation need to be confirmed or overruled by new butchery reference collections.

C - Summary and discussion

The initial results of the analysis of the reindeer bone remains from Facies 4a document several stages in the butchery *chaîne opératoire*: skinning, defleshing, disarticulation, and tendon removal.

The cutmarks produced during skinning reflect a great diversity in the way this step of the *chaîne opératoire* was conducted. Circular incision marks were observed from the mesial phalanges to the distal tibia, without any particular location appearing to have been favoured, and the longitudinal incision was carried out on both the medial and lateral faces of the limb. This variability could indicate a lack of interest in the skin, with skinning performed solely in order to access the meat and the marrow. However, the reindeer were – at least in some cases – slaughtered in late summer and early fall (Soulie *et al.*, in prep.), a time when the skin was of optimal quality. Ethnographic reports indicate that the skin is particularly valued at this time of year by societies living in cold climates (e.g. Jenness, 1946; Sonnenfeld, 1960; Hatt, Taylor, 1969; Binford, 1978; Stenton, 1991; Wachowich, 2014), particularly for producing winter clothing as it is light but warm (Binney, 1929; Stenton, 1991). Given that around 30 reindeer skins are needed to meet the annual needs of a family (Vézinet, 1980; Issenman, 1997), it seems highly likely that this raw material was just as sought after by prehistoric groups (especially those that evolved in cold climates) as by present-day populations of (sub-)Arctic zones. Autumn migration is thus an ideal opportunity to acquire large quantities of high-quality skins. The variability observed on the bones from Les Pradelles therefore seems more likely to indicate a diversity in hide use. Skinning methods – and the way in which the hide is worked – are directly related to the hide will be used (e.g. Balikci, 1970; Rajagopalan, 2003; Beyries, 2008), and/or indicate that this operation was carried out by people with different habits or degrees of expertise.

The abundance of cutmarks on the fleshy long bones demonstrates intensive defleshing of carcasses. Indeed, defleshing cutmarks are likely to have been produced only during the removal of the deep muscles. These high percentages of cutmarks also tend to suggest that defleshing took place when the meat was raw, since cooked meat comes off the bone easily and produces few

cutmarks (Abe, 2005; Costamagno, David, 2009). Although this data remains to be quantified, the high occurrence of longitudinal cutmarks observed in this assemblage could, according to the data produced by Soulier and Morin (2016), indicate that defleshing was conducted with the intention to dry the meat. This hypothesis is supported by the season of slaughter (autumn migration, which allows a large number of individuals to be captured in a short space of time) and by the large number of reindeer identified (MNI=58), and is in line with the hypotheses previously put forward for other assemblages from this site (Costamagno *et al.*, 2006). The scarcity of articular extremities has prevented us from determining the frequency of disarticulation. It has furthermore been suggested that this low occurrence of articular fragments is due to the crushing of these spongy parts in order to obtain grease (Costamagno, 2013). Although only supported by a limited number of examples, the analysis of the material nevertheless revealed signs of disarticulation at each joint.

Finally, the tendons of the lower legs were retrieved, as demonstrated by the numerous longitudinal and (sub-)transverse cutmarks produced on the metatarsal and phalanges during this activity. The abundance of these cutmarks indicates that this activity was performed on a large proportion of the carcasses present.

Whatever the type of activity considered, the analysis of the cutmarks observed on the reindeer bone remains from Les Pradelles reflects a certain diversity in the actions performed. This apparent lack of standardization may indicate that several people were involved in the carcass processing – a hypothesis that is highly probable given the number of reindeer treated and the activities that were carried out. Indeed, the carcasses had to be quickly processed after the death of the animal, whether for the primary processing of the skins or for the preparation of the meat. In terms of the meat, if it was indeed removed to be dried¹, this was a lengthy process to complete, which required significant cooperation between individuals. The analysis of the cutmarks present on the reindeer bone remains from Les Pradelles illustrates the intense and diverse exploitation of the carcasses. The data not only suggests that reindeer exploitation was planned and highly organized, but also that it occupied a special place in the annual cycle of this late Middle Palaeolithic society.

2 - Interpreting the butchery marks: grotte du Noisetier (Fréchet-Aure, Hautes-Pyrénées) (C. Lemeur, A. Val, S. Costamagno)

A - Relating the cutmarks to the gesture used

a - Corpus and methodology

The analysis of the butchery marks focused on the four levels of Grotte du Noisetier where the most evidence of human activity has been documented: layers 2, 33, 3 and gb (figure 199). In these layers, there was a decrease in semi-digestion marks, which were present on less than 30 % of the material, unlike in the other levels, where the frequency reached up to 58 % (Costamagno in Mourre *et al.*, 2010). Traces of anthropogenic origin were much more numerous there, particularly in layers 2 and 3, where over a third of the pieces presented marks related to human activity. Although the Pyrenean chamois was the most abundant species in three of these four levels, taphonomic studies indicate that this ungulate had largely natural origins (Costamagno *et al.*, 2008; Mallye *et al.*, 2012) unlike the red deer, which was the most hunted prey by the Neanderthals who occupied the cave (table 52). The analysis therefore focused on this species. Only the long bone remains were studied, i.e. 58 remains in layer 33; 12 in layer 2; 53 in layer 3; and 28 in layer gb (table 53).

1. If the meat was processed directly on site, we can exclude the smoking of the meat due to the absence of any evidence of fire.

An almost identical protocol to that used for the reindeer remains from Les Pradelles was applied to the bone remains from Grotte du Noisetier. However, the cutmarks were documented using Quantum GIS and not Adobe Illustrator® (Lemeur, 2016) in order to allow a quantitative approach. This analysis, which was conducted as part of a Master's thesis, was very limited due to the low number of remains involved. We have therefore chosen to present only the results of the qualitative approach here.

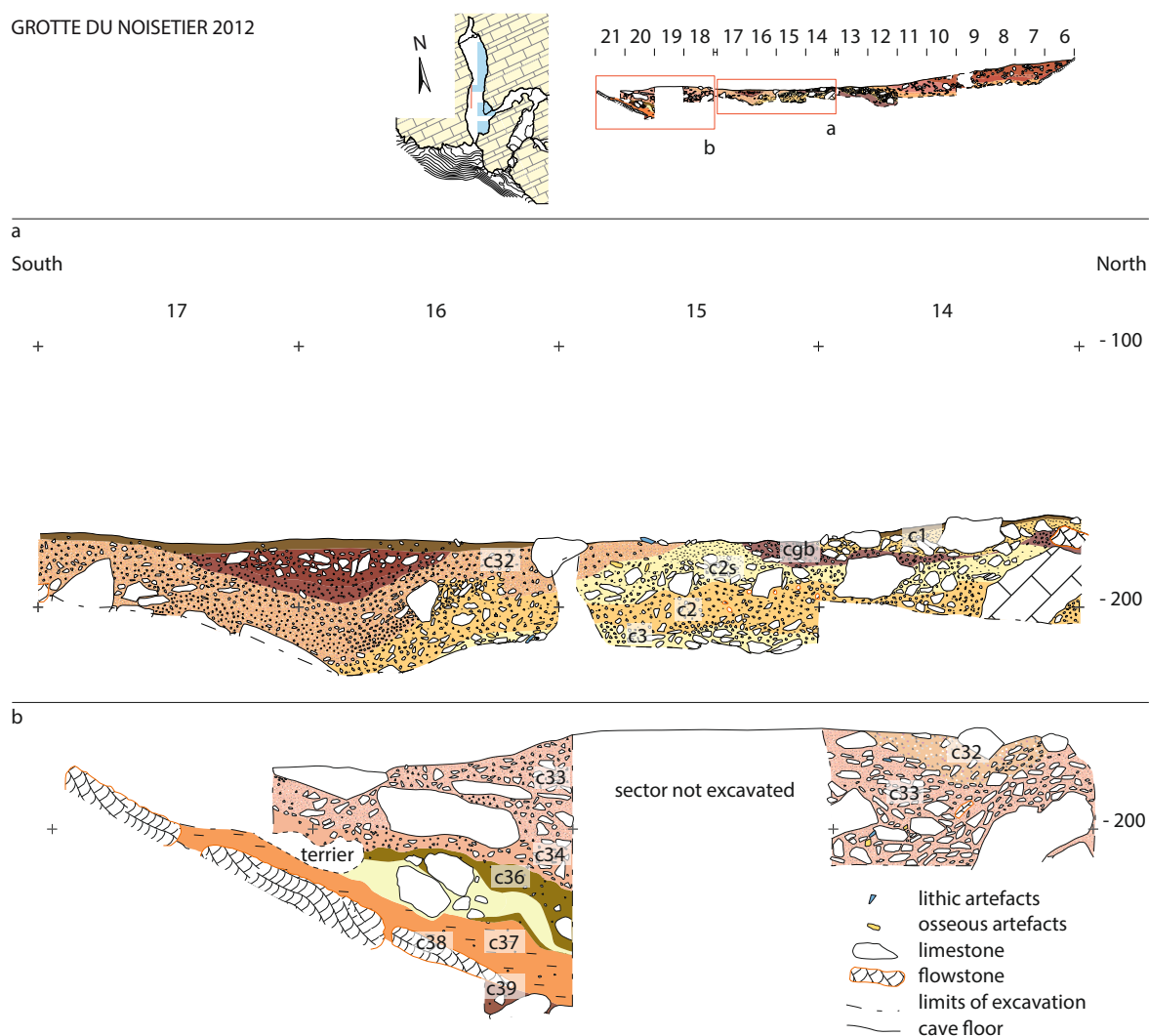


Figure 199 - Stratigraphic sequence from Grotte du Noisetier at the location of a: layer C/D 18-21; b: layer B/C 14-17 (CAD: V. Mourre).

	Layer 2		Layer 3		Layer gb		Layer 33	
	NISP	%NISP	NISP	%NISP	NISP	%NISP	NISP	%NISP
Cave bear	-	-	-	-	-	-	-	-
Panther	-	-	-	-	3	1	-	-
Lynx	-	-	-	-	-	-	-	-
Wolf	-	-	-	-	-	-	1	0.2
Cuon	-	-	-	-	3	1	-	-
Fox	2	1.7	-	-	10	3.2	5	0.9
Unidentified canids	-	-	1	1	2	0.6	6	1.1
Badger	-	-	-	-	-	-	-	-
Unidentified carnivores	-	-	-	-	4	1.3	1	0.2
Bison	-	-	-	-	1	0.3	-	-
Large bovids	5	4.3	4	4.2	12	3.8	6	1.1
Ibex	11	9.5	3	3.2	42	13.5	69	12.5
Chamois	55	47.4	28	29.5	181	58.2	360	65.4
Medium bovids	5	4.3	1	1	2	0.6	7	1.3
Red deer	27	23.3	55	57.9	47	15.1	45	8.2
Roe deer	-	-	-	-	-	-	-	-
Cervids	-	-	-	-	2	0.6	1	0.2
Horse	-	-	2	2.1	-	-	-	-
Leporid	1	1	-	-	2	0.6	11	2
Marmot	10	8.6	1	1	-	-	38	6.9
Total	116	100	95	100	311	100	550	100

Table 52 - Faunal spectrum for layers 2, 3, gb, 33 at Grotte du Noisetier in number of identified specimens (NISP) (after Costamagno *in* Mourre *et al.*, 2010).

	Layer 2			Layer 3			Layer 33			Layer gb		
	N	Ncut	MNE	NR	NRcut	MNE	NR	NRcut	MNE	NR	NRcut	MNE
Humerus	3	0	1	2	1	2	2	2	1	3	2	2
Radius	2	1	2	13	8	10	5	3	3	1	1	1
Ulna	-	-	-	2	1	2	-	-	-	1	0	1
Metacarpal	3	2	1	16	9 + RAC	5	10	8	6	8	4	3
Femur	1	RAC	1	4	3	2	13	7	4	2	1	1
Tibia	2	2	1	8	4 + RAC	4	17	11	8	6	3	5
Metatarsal	1	0	1	8	2	4	11	7	6	7	2	3
Total NISP	12	6		53	30		58	38		28	13	

Table 53 - Number of specimens (NISP), number of specimens with cutmarks (NISPcut) and minimum number of skeletal elements (MNE) of red deer in layers 2, 3, 33, and gb at Grotte du Noisetier. Abréviations : RAC : scraping marks.

b - Results

Cutmarks were respectively present on 50, 57, 65, and 46 % of the long bone fragments from layers 2, 3, 33, and gb.

Skinning

Layer 2

No skinning marks were observed on the remains from layer 2.

Layer 3

In this layer, evidence of the skinning stage was only observed on fragments of the metapodials. Incision zones, indicated by transverse cutmarks, were visible on the lateral surface at several points along the metacarpal diaphysis (*Mcs-b''*) and the proximal part of the metatarsal (*Mts-b''*) (figure 200). Longitudinal cutmarks were also observed, reflecting the vertical incision of the skin from the distal circular incision up to the ventral incision or up to a circular incision made at another point along the leg. One of these was located on the medial surface of the diaphysis (*Mcs-a'*), while two others were present on the lateral surface (*Mcs-b'*). Oblique cutmarks were visible on the proximal and distal parts of the anterior surface as well as on the diaphysis of the lateral surface (*Mcs-d* and *Mcs-b*), reflecting gestures made to detach the skin. Those present on the lateral surface in the middle of the diaphysis were found on a fragment presenting circular incision marks. Located on either side of this transverse mark, they suggest that the skin was removed on either side of the incision zone.

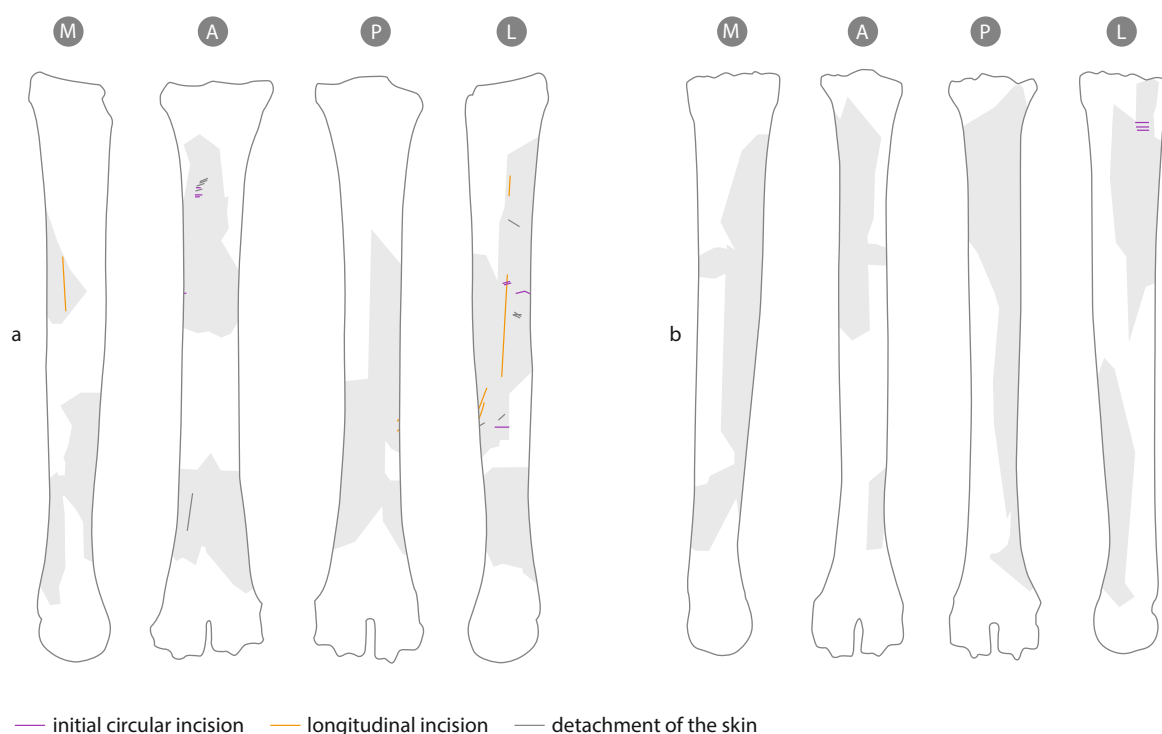
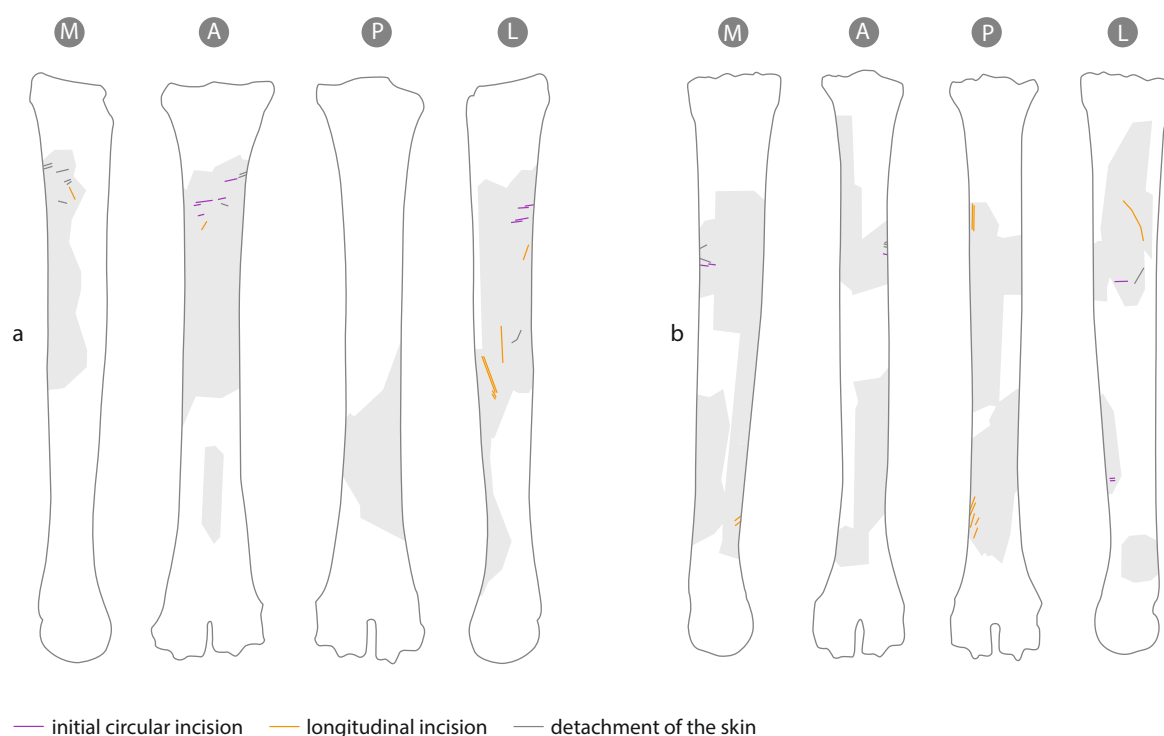


Figure 200 - Cutmarks from skinning observed on material from layer 3 at Grotte du Noisetier on a: the metacarpal; b: the metatarsal. All of the fragments identified are indicated in grey. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur and M. Coutureau).

Layer 33

Evidence of skinning could be observed on some metacarpal and metatarsal remains. On the metacarpal, several sub-transverse cutmarks located on the proximal part of the anterior surface and continuing onto either the lateral or medial surface (*Mcs-a''* and *Mcs-b''*) were comparable to cutmarks related to the circular incision of the skin (figure 201^a). Unlike the incision zones identified by transverse cutmarks, these marks were slightly oblique. However, the depth of these marks suggested they were related to this skinning stage. The presence of a cutmark on the diaphysis of the lateral surface (*Mcs-b'*) indicates the longitudinal incision of the skin. Finally, cutmarks related to the detachment of the skin (*Mcs-a* and *Mcs-b*) were observed on the proximal part of the bone. On the metatarsal, cutmarks associated with the circular incision of the skin were visible on the lateral surface (*Mts-b''*) on the middle and distal diaphysis (figure 201^b). Two longitudinal cutmarks located on the posterior surface of the proximal diaphysis, close to the lateral surface, could indicate longitudinal incisions (*Mts-a'*). Oblique cutmarks visible on the distal part of the posteromedial surface (*Mts-a*) as well as on the diaphysis of the lateral surface (*Mts-b*) indicate the detachment of the skin.



— initial circular incision — longitudinal incision — detachment of the skin

Figure 201 - Cutmarks from skinning observed on material from layer 33 at Grotte du Noisetier on a: the metacarpal; b: the metatarsal. All of the fragments identified are indicated in grey. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur and M. Coutureau).

Layer gb

In layer gb, skinning could be observed on metacarpal, metatarsal and tibia remains. On the metacarpal, the cutmarks related to this step were located on the distal part of the anterior and medial faces (figure 202^a). They correspond to circular incisions (*Mcs-a''* and *Mcs-d*), longitudinal incisions on the medial surface (*Mcs-a'*) and gestures made to detach the skin (*Mcs-a*). On the metatarsal, only relatively short, oblique cutmarks were observed on the lateral surface, also corresponding to the detachment of the skin (*Mts-b*) (figure 202^b). Finally, a tibia remain presented a longitudinal cutmark on the distal part of the medial surface that could either correspond to this skinning phase or to defleshing (*Ts-b'*) (figure 202^c).

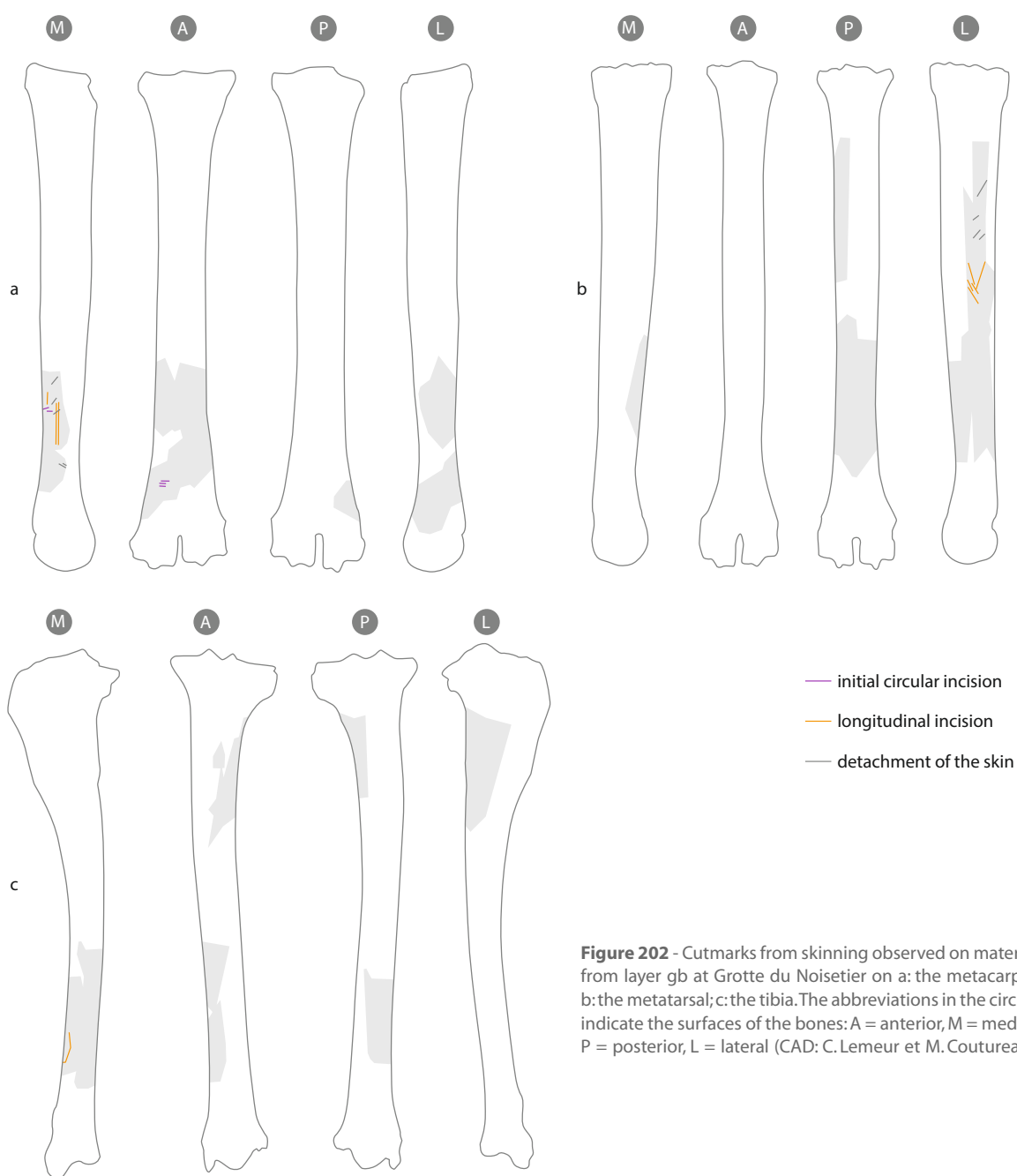


Figure 202 - Cutmarks from skinning observed on material from layer gb at Grotte du Noisetier on a: the metacarpal; b: the metatarsal; c: the tibia. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur et M. Coutureau).

Defleshing

Marks related to defleshing activities were visible on the bone fragments with the most flesh (the humerus and femur) as well as on the bones of the zeugopodium (the radio-ulna and tibia).

Layer 2

The defleshing stage was visible on the radius and tibia. No fragment bore evidence of the removal of the meat from the humerus or femur (table 53). On the radius, elongated longitudinal marks were visible on the proximal part of the anterior surface (Rs-a'), produced by the extraction of the extensor carpi radialis muscle (figure 203^a). On the tibia, short oblique cutmarks were observed on the proximal part of the lateral surface of the middle diaphysis (Ts-c). These marks were located in the area of the cranial tibial muscle insertion (figure 203^b).

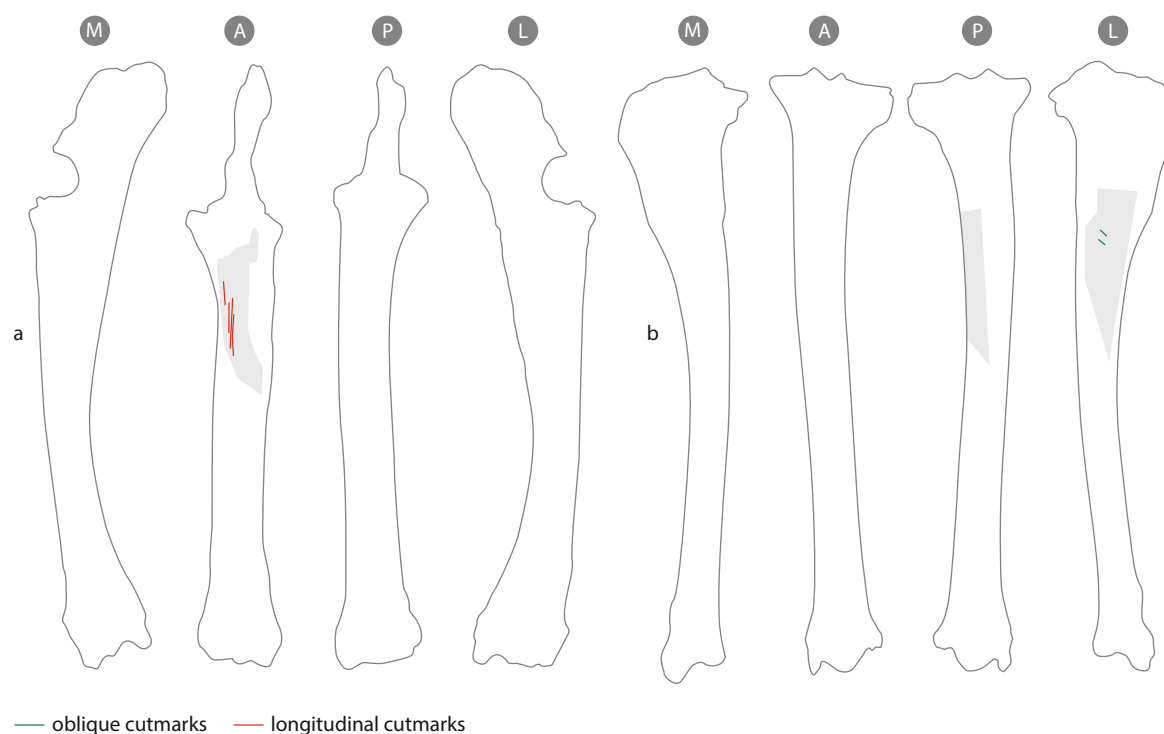


Figure 203 - Cutmarks from defleshing observed on material from layer 2 at Grotte du Noisetier on a: the radius and ulna; b: the tibia. All of the fragments identified are indicated in grey. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur and M. Coutureau).

Layer 3

In layer 3, all the fleshy bones bore cutmarks related to this butchery stage (table 53). A cutmark present on the distal diaphysis of a humerus could be either a defleshing or a disarticulation mark (Hd-b) (figure 204^a). The radius presents transverse, oblique, and longitudinal defleshing marks on the proximal diaphysis (Rs-a, Rs-a') (figure 204^c). These marks indicate the removal of the *extensor digitorum* muscle and the *extensor carpi radialis*. Those located on the posterior diaphysis were associated with the removal of the *pronator teres* muscle (Rs-a) and the *flexor carpi radialis* (Rs-a'). Cutmarks visible on the distal part of the lateral surface indicate the removal of the *lateral digital extensor* muscle (Rs-b). On the ulna, a longitudinal cutmark located on the lateral surface was

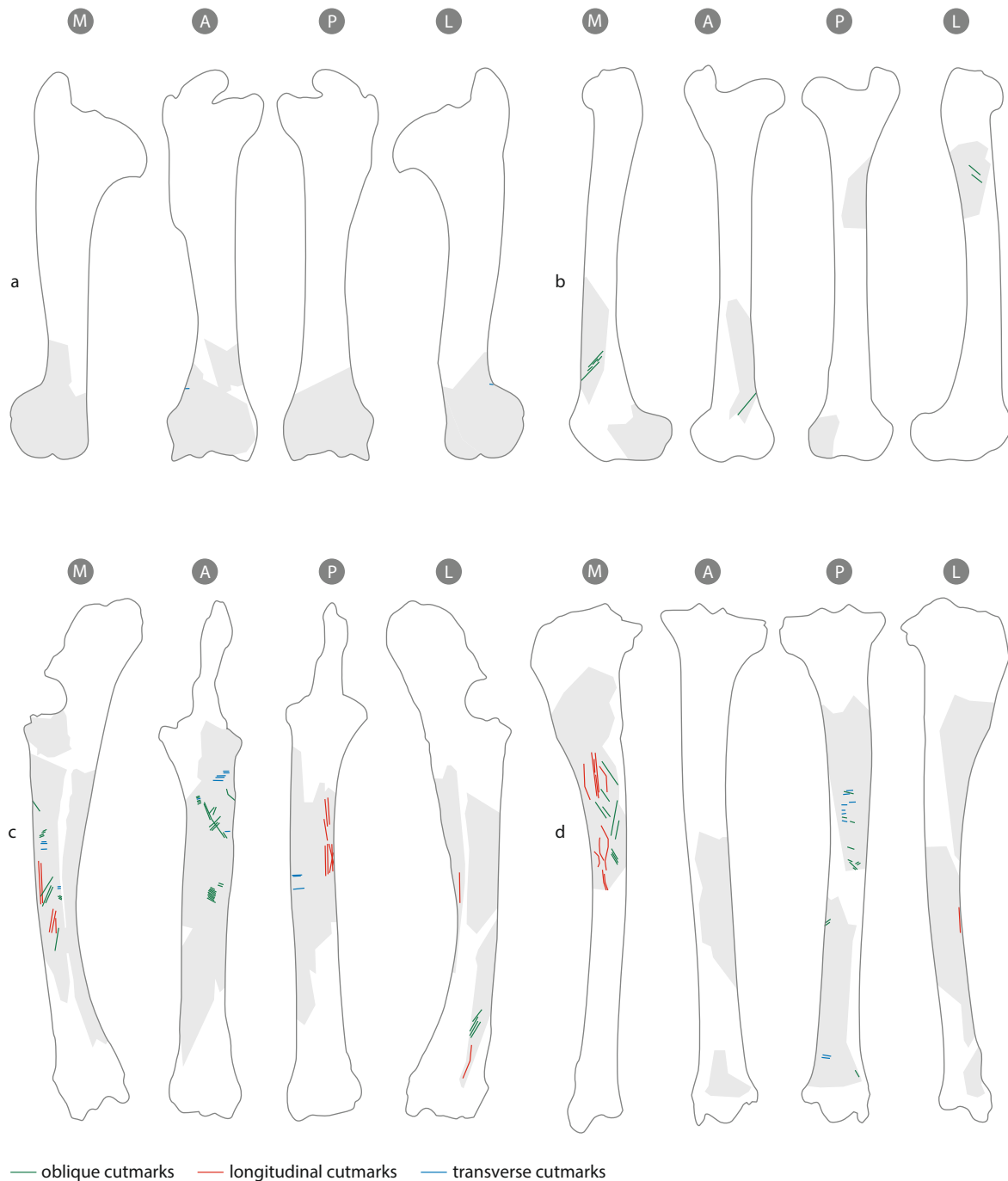


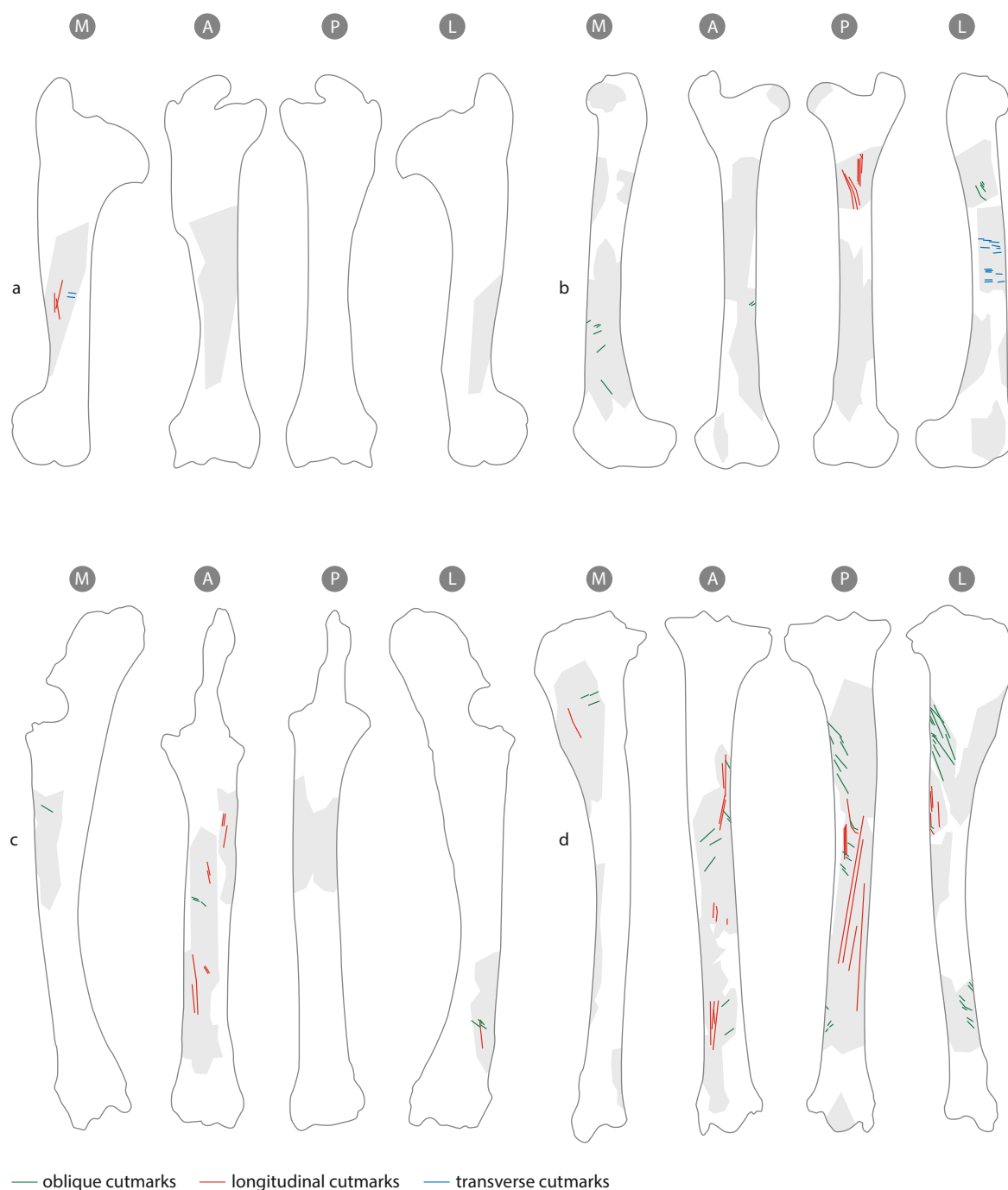
Figure 204 - Cutmarks from defleshing observed on material from layer 3 at Grotte du Noisetier on a: the humerus; b: the femur; c: the radioulna; d: the tibia. All of the fragments identified are indicated in grey. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur and M. Coutureau).

produced by the defleshing of the *ulnaris lateralis* muscle (*Us-a*) (figure 204^b). The presence of *Fs-a* cutmarks on the distal and proximal femur indicate the removal of the *vastus medialis* muscle and the deep gluteal muscle (figure 204^c). On the tibia, transverse and oblique cutmarks on the anterior surface correspond to the removal of the *extensor digitorum longus* muscle (*Ts-c*, *Ts-c'*, *Ts-e*, *Ts-e''*) (figure 204^d). Other oblique and longitudinal cutmarks (*Ts-b*, *Ts-b'*) located on the medial surface demonstrate the removal of the medial digital flexor muscle.

Layer 33

In layer 33 (table 53), defleshing was visible on the humerus (*Hs-a*, *Hs-a'*), radius (*Rs-a*, *Rs-a'*, *Rs-b*, *Rs-b'*, *Rs-c*, *Rs-c'*), femur (*Fs-a*, *Fs-a'*) and tibia (*Ts-a*, *Ts-e*, *Ts-e'*).

A humerus remain presented cutmarks with varying orientations (figure 205^a). The transverse marks were located in the area of the *coracobrachialis* muscle insertion. Other oblique or even longitudinal cutmarks were related to the removal of the *triceps brachii*.



— oblique cutmarks — longitudinal cutmarks — transverse cutmarks

Figure 205 - Cutmarks from defleshing observed on material from layer 33 Grotte du Noisetier on a: the humerus; b: the femur; c: the radioulna; d: the tibia. All of the fragments identified are indicated in grey. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur and M. Coutureau).

On the radius, oblique and longitudinal cutmarks were visible on the anterior diaphysis where the extensor carpi radialis muscle is located (figure 205^c). In the distal part, oblique marks reflected the defleshing of the lateral digital extensor muscle (*Rs-b*, *Rs-b'*). A cutmark also testified to the removal of the brachialis muscle on the medial surface (*Rs-a*). On the femur, oblique and transverse cutmarks (*Fs-a*) were present over the entire diaphysis in the area of the vastus medialis muscle insertion (figure 205^b). Several longitudinal cutmarks (*Fs-a'*) were visible on the proximal part of the posterior surface, reflecting the removal of the gluteal muscles. On the tibia, oblique cutmarks (*Ts-a*) were observed on the proximal part of the anterolateral surface in the area of the cranial tibial muscle insertion (figure 205^d). On the posterolateral surface, longitudinal (*Ts-c'*) and oblique (*Ts-c*) cutmarks demonstrated the removal of the lateral digital flexor muscle. On the medial surface, oblique cutmarks (*Ts-a*) testified to the removal of the popliteus muscle and the gracilis muscle located nearer the tibial crest. Finally, on the anterior surface, as well as oblique cutmarks, lengthy longitudinal cutmarks were observed in the area of the *extensor digitorum longus* muscle.

Layer gb

Defleshing marks were observed on the humerus, radius and tibia in layer gb (table 53).

On the humerus, oblique cutmarks (*Hs-a*) were visible on the posterior diaphysis in the area of the *anconeus* muscle insertion (figure 206^a) and on the distal part where the *brachialis* muscle is located. On the radius, cutmarks were present on the posterior surface (*Rs-b'*) in the area of the flexor digitorum muscle (figure 206^b). On the tibia, cutmarks (*Ts-a* and *Ts-a'*) were observed on the proximal part, reflecting the removal of the popliteus muscle (figure 206^c). Others marks on the distal tibia, testified to the removal of the extensor digitorum longus muscle (*Ts-c*). An oblique cutmark (*Ts-b*) was observed on the middle of the diaphysis on the medial surface in the area of the medial digital flexor muscle insertion.

Disarticulation

The disarticulation process was difficult to observe on the red deer bone remains from Grotte du Noisetier. This was largely due to the low number of articular extremity remains (Costamagno, Rigaud, 2014). These anatomical parts were represented only by five distal extremities from layers 3 and 33 (three femora, one tibia and one humerus) and three proximal extremities retrieved from layers 2, 3, and 33 (one femur and two radii). Of these eight pieces, only one of them, from layer 3, presented a cutmark that might correspond to the disarticulation of the elbow (*Hd-b*) (figure 204^a).

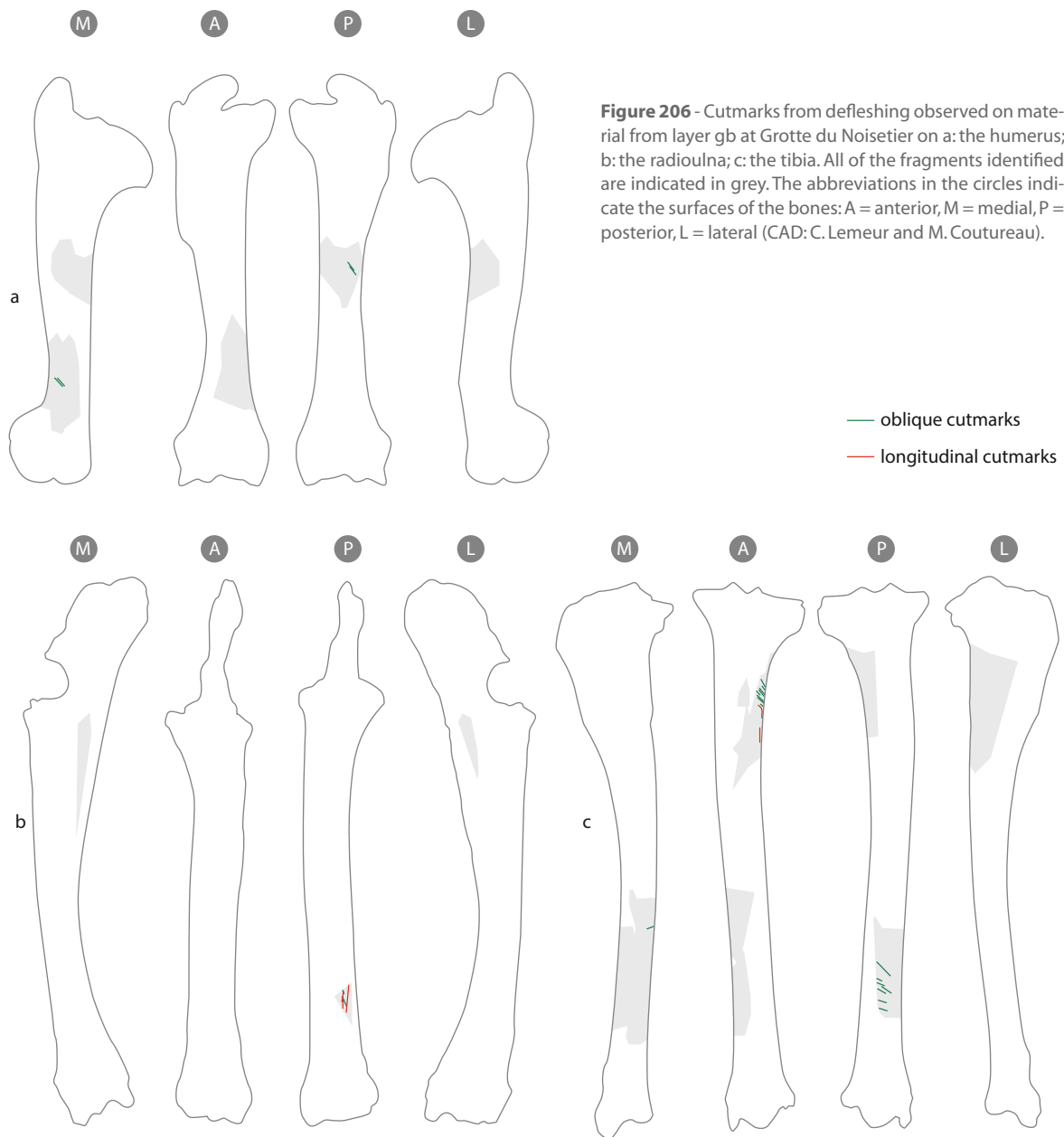
Tendon removal

Layer 2

In layer 2, the presence of short, oblique and transverse cutmarks in the middle of the diaphysis on either side of the medial groove on the anterior surface of the metacarpal (*Mcs-c* and *Mcs-d*), suggests the removal of the digital extensor tendons (figures 207^a, 208). No marks were visible on the metatarsal.

Layer 3

The removal of the extensor tendon was reflected on the metacarpal fragments from Layer 3 by oblique (*Mcs-c* and *Mcs-d*) and longitudinal (*Mcs-c'*) cutmarks, either on the proximal part or on either side of the medial groove (figure 207^b). An elongated longitudinal cutmark (*Mts-c'*) located in the posterior gutter of a metatarsal fragment indicated the removal of the flexor tendon (figure 209^a).



Layer 33

Transverse and oblique cutmarks (*Mcs-c*) were observed on some metacarpal fragments on either side of the anterior medial groove, reflecting the removal of the extensor tendon (figure 207^c). On the posterior surface, a medium-length longitudinal cutmark (*Mcs-f*), and two oblique cutmarks (*Mcs-f*) were produced by the removal of the flexor tendon. On the metatarsal, a short, longitudinal cutmark (*Mts-c*) related to the removal of the extensor tendon was observed in the anterior gutter (figure 207^b).

Layer gb

In layer gb, the removal of the extensor tendons of the metacarpal was reflected by short, oblique cutmarks (*Mcs-d*) and a longitudinal cutmark located in the distal groove (figure 207^d). No marks related to this activity were visible on the metatarsal.

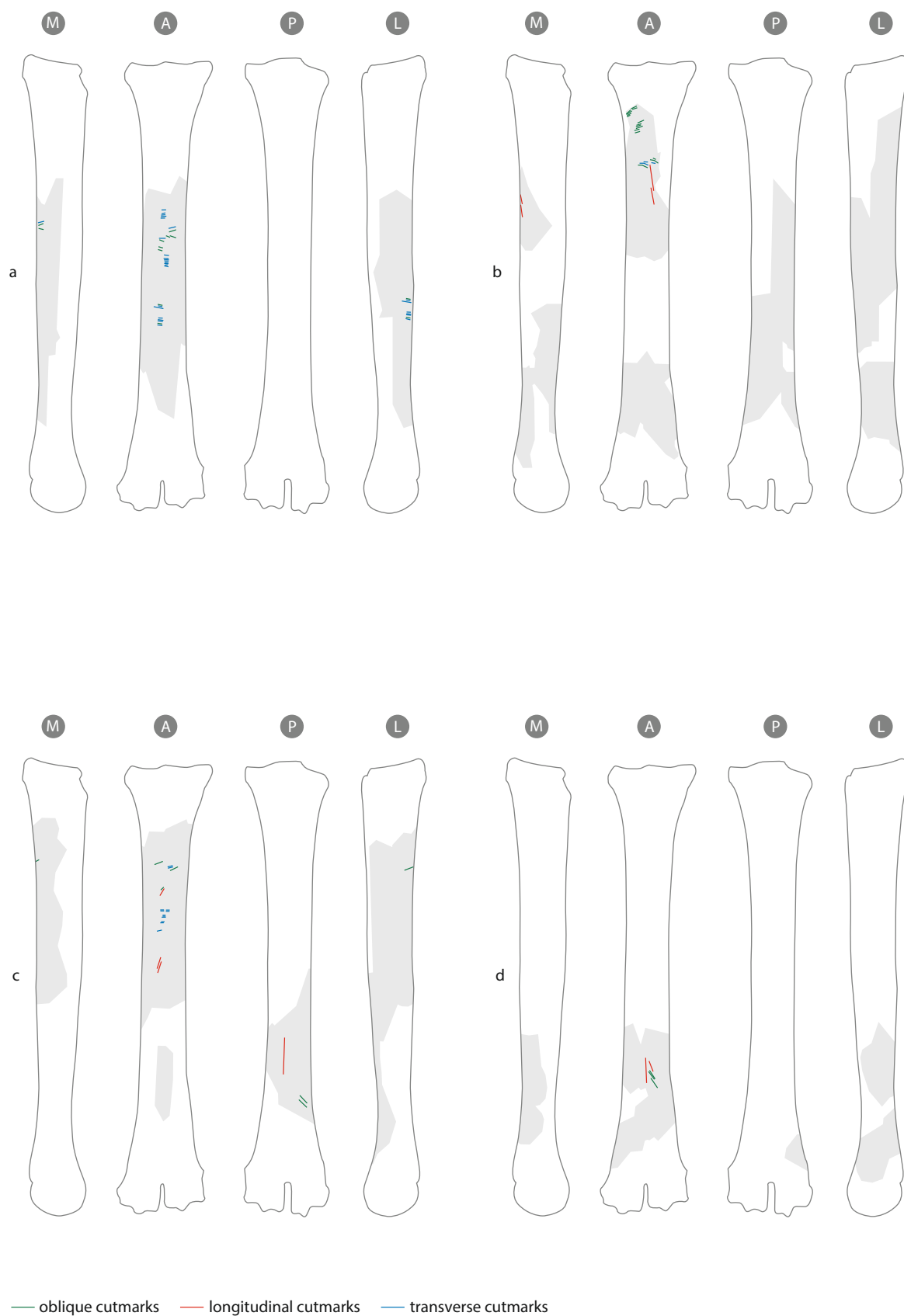


Figure 207 - Cutmarks from the removal of tendons on the remains of red deer metacarpals from a: layer 2, b- layer 3; c: layer 33; d: layer gb. All of the fragments identified are indicated in grey. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur and M. Coutureau).



Figure 208 - Fragment of red deer metacarpal bearing cutmarks related to the removal of tendons (layer 2) (photographs: J. Vigui r).

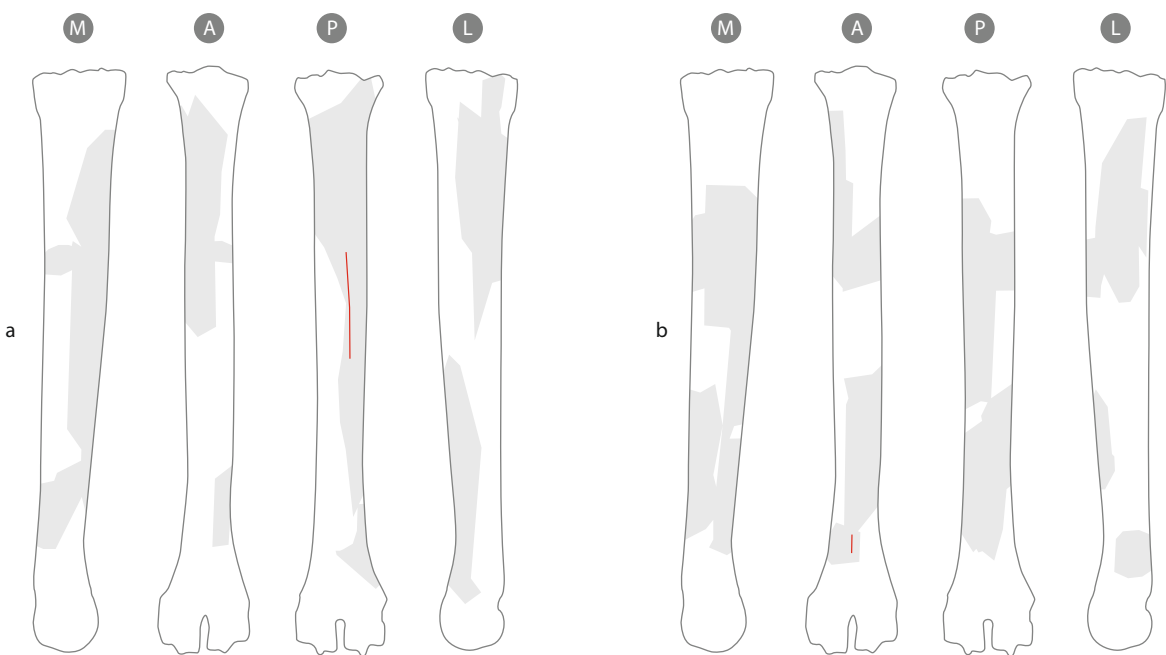


Figure 209 - Cutmarks related to the removal of tendons on the remains of red deer metatarsals from a: layer 3; b: layer 33. All of the fragments identified are indicated in grey. The abbreviations in the circles indicate the surfaces of the bones: A = anterior, M = medial, P = posterior, L = lateral (CAD: C. Lemeur and M. Coutureau).

c - Discussion

At Grotte du Noisetier, despite the small sample size, distributed over several stratigraphic units, some interesting results can be highlighted. These results show different stages in the butchery *chaîne opératoire* for red deer: skinning, defleshing and tendon removal. With regard to disarticulation, the very small sample size due to the absence of articular extremities and carpal / tarsal bones (Costamagno, Rigaud, 2014), has prevented us from drawing any firm conclusions, but it is likely that disarticulation was relatively extensive.

Skinning could be observed on metapodial remains from layers 3, 33 and gb. This stage in the butchery *chaîne opératoire* is essential before the removal of the tendons or the fracturing of the bones to recover the marrow. The skin could either have been actively sought in order to meet various needs (clothing, bags, blankets, boots, ...) or abandoned at the slaughter site after initial butchery. It is difficult to discuss the recurrence of butchery marks at Grotte du Noisetier, but it can be noted that, as far as skinning marks are concerned, there does not appear to have been any specific cutting method. The initial circular incisions were located at different heights along the metapodials, as were the longitudinal incisions, which were observed on the lateral, medial and even anterior faces (table 54). The presence of longitudinal incisions on the medial and lateral faces may reflect two distinct techniques for removing the skin. In the first case, this incision may have been made with the aim of connecting with the ventral incision – which was essential in order to eviscerate the animal – to produce a single piece of skin (potentially layers gb and 3). However, the presence of longitudinal cutmarks on this surface is not sufficient to affirm that the skin was removed in one piece, as the skin of the legs may nonetheless have been removed separately (Costamagno, 2012). In the second case, the presence of longitudinal cutmarks on the lateral surface indicates that the skin of the legs was removed separately from that of the rest of the carcass (layers 3 and 33), as is observed in different Siberian groups (Costamagno, David, 2009). This skinning method may suggest that this phase took place in two stages and possibly in two different locations (Costamagno, David, 2009). While in Layer 3 both techniques appear to have been used, reflecting a low degree of standardization in the removal of skin from the lower legs, for levels 33 and gb, only one method has been observed (table 54), but the limited size of the samples does not allow us to go beyond this simple observation.

	METACARPAL					METATARSAL				
	Circular incision			longitudinal incision		Circular incision			Longitudinal incision	
	Proximal shaft	Middle shaft	Distal shaft	Medial surface	Medial surface	Proximal shaft	Middle shaft	Distal shaft	Medial surface	Medial surface
Layer 2										
Layer 3										
Layer 33										
Layer gb										

type of cutmark is present
 type of cutmark is absent
 piece that could provide evidence of this stage of skinning is absent

Table 54 - Location of cutmarks from skinning in relationship to zones of the initial circular incisions and longitudinal incisions on metacarpal and metatarsal fragments from layers 2, 3, 33 and gb.

Defleshing marks were observed on the fleshy bones of the fore and hind legs from the four layers studied. At Grotte du Noisetier, 57.5 % of these bones presented butchery marks. The high number of cutmarks on the fleshy bones indicates that the meat was removed raw (Costamagno, David, 2009). Depending on the level and the skeletal element concerned, the orientation of the cutmarks varied significantly. The defleshing marks were mostly oblique, but longitudinal cutmarks were nonetheless present in significant proportions, which could suggest that the meat was removed in the form of fillets (Nillsen, 2000; Soulier, Morin, 2016) with the exception of layer gb. Nevertheless, the experiments conducted during the PCR have shown that longitudinal cutmarks can occur during normal butchery. Furthermore, not all the bones presented this type of mark, whereas when fillets are removed, the entire leg is subject to cutting (Soulier, *pers. comm.*). With the data currently available, the hypothesis of the removal of fillets at Grotte du Noisetier for delayed consumption therefore seems difficult to support.

The cutmarks observed on the metapodials also reflect the Neanderthals' intention to collect the leg tendons. In light of the available data, the metacarpal extensor tendon seems to have been particularly favoured, as cutmarks relating to this activity have been repeatedly observed in all four levels (table 55). On the other hand, the flexor tendons of the fore leg seem to have been less valued, as were the tendons of the hind leg. The reasons for this choice are difficult to establish. Nonetheless, the Neanderthals' attraction for this type of tendon could be related to its thinness, which would have made it easier to dry, thus allowing more rapid use, perhaps in the site itself. The cutmarks observed on the red deer long bones from Grotte du Noisetier attest to various butchery activities related to the group's food and technical needs. The exploitation of the marrow and the grease contained in the articular extremities (Costamagno, 2013) reflects the integral processing of red deer carcasses as well as of other large bovids, which received to the same attention (Costamagno, 2013).

	METACARPAL		METATARSAL	
	Removal of extensor tendon	Removal of flexor tendon	Removal of extensor tendon	Removal of flexor tendon
Layer 2				
Layer 3				
Layer 33				
Layer gb				

type of cutmark is present
 type of cutmark is absent
 piece that could provide evidence of this stage of butchery is absent

Table 55 - Removal of the extensor and flexor tendons from the lower legs in layers 2, 3, 33 and gb.

B - Relating the cutmarks to the tool used

a - Corpus and methodology

The archaeological sample analyzed consisted of 102 red deer long bone fragments (14 humeral fragments, 20 radial fragments, 17 femoral fragments and 51 tibial fragments) from different stratigraphic units (layers 1 to 5, 31 to 36, gind and sf, see figure 199). Amongst the 38 (MNE) long bones that formed the latter, 37 bone fragments presented cutmarks, representing a minimum number of 23 long bones. Two-hundred and sixteen cutmarks (n=450 taking into account all the

secondary cutmarks) were identified and described using an optical microscope. All the variables considered during the microscopic analysis of the cutmarks in the experimental reference collection were recorded in the corpus of cutmarks (table 56). The average number of cutmarks was 5.7 per bone, or 11.8 when including the secondary cutmarks.

1.	Trajectory	straight = 123/215 (57 %) curvy = 43/215 (20 %) sinuous = 92/215 (43 %)
2.	Barb effect	present = 11/215 (5 %) absent = 204/215 (95 %)
3.	Shape of the groove	V = 192/212 (91 %) ∟ = 20/212 (9 %)
4.	Symmetry of the groove	symmetrical = 67/201 (33 %) asymmetrical = 134/201 (67 %)
5.	Shoulder effect	present = 142/216 (66 %) absent = 74/216 (34 %)
6.	Flaking	present = 11/216 (5 %) absent = 205/216 (95 %)
7.	Extent of the flaking	>1/3 = 3/11 (27 %) <1/3 = 8/11 (73 %)
8.	Micro-striations	present = 50/216 (23 %) absent = 166/216 (77 %)
9.	Trajectory of the micro-striations	continuous = 38/50 (76 %) discontinuous = 12/50 (24 %)
10.	Shape of the micro-striations	régulières = 50/50 (100 %) irrégulières = 0/50 (0 %)
11.	Location of the micro-striations	one/stwo edge(s) = 13/50 (26 %) edge & bottom = 6/50 (12 %) between the groove and the shoulder = 31/50 (62 %)
12.	Multiple marks	present = 111/216 (51 %) absent = 105/216 (49 %)
13.	N. multiple marks	between 2 & 9
14.	Fork-shaped marks	present = 39/216 (18 %) absent = 177/216 (82 %)
15.	N. fork-shaped marks	between 1 & 4
16.	Intersecting marks	present = 12/111 (11 %) absent = 99/111 (89 %)

Table 56 - Morphological characteristics of the cutmarks observed on the study sample from Grotte du Noisetier.

b - Results

There was no clear and statistically significant differences in our experimental reference collection between the cutmarks produced by the flakes, unretouched point and cleavers and those produced by the tools with retouched edges. As a result, it proved impossible to attribute the cutmarks observed on the remains from Grotte du Noisetier to one lithic type rather than another. It was also impossible to exclude any of the elements considered (unretouched flakes, unretouched points, Mousterian points, denticulates, or flake cleavers) from the tool kit potentially used by the occupants of the cave during cutting the carcasses.

Several points are worth mentioning however. First of all, the unexpected abundance of both cutmarks and micro-striations in the archaeological sample. Despite the highly likely action of post-depositional processes such as trampling, weathering and fragmentation, the butchery marks were as numerous in the archaeological sample as those produced by the flakes and the unretouched point in our experimental reference collection and only slightly less abundant than those

produced by the denticulates and cleavers in the same reference collection (in the latter two cases, this slight difference was not statistically significant; $p > 0.05$ each time). Similarly, on the remains from Grotte du Noisetier, micro-striations were present in 23 % of the cutmarks, consistent with the results obtained for the retouched tools in the experimental sample. However, this percentage was not statistically higher than that observed for the cutmarks produced by the unretouched blanks ($X^2 = 2.30$; $p > 0.05$).

Finally, the specific arrangement of the cutmarks (“type 1” and “type 2”) associated with the butchery marks produced by the denticulates in the experimental reference collection were also observed on some bone remains from Grotte du Noisetier. “Type 2” was identified on one fragment and “type 1” on 13 (figure 210).

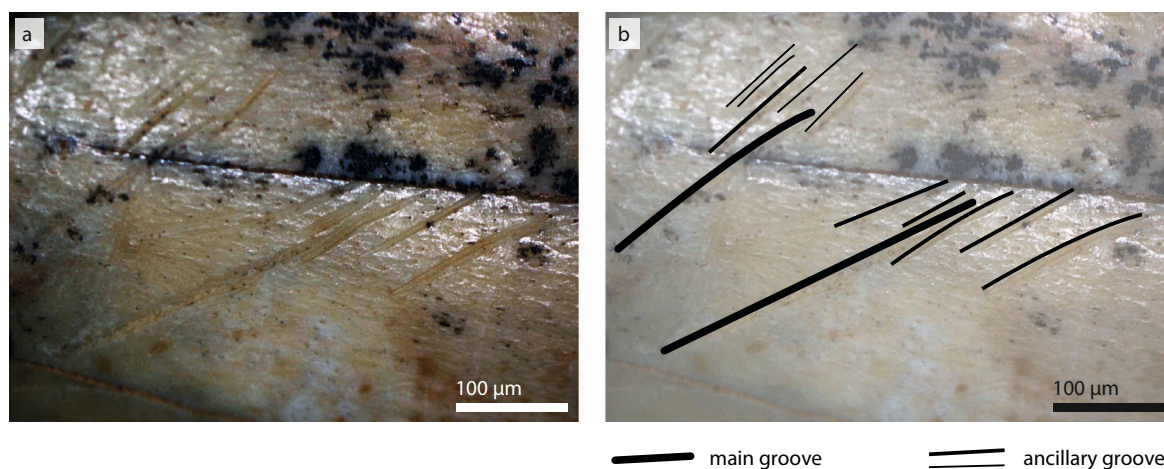


Figure 210 - Cutmarks corresponding to “type 1”, associated with cutmarks left by denticulates, observed on a fragment of radius shaft of a red deer recovered from Grotte du Noisetier (photographs: A. Val).

c - Discussion

The identification of two specific types of arrangement of cutmarks, exclusively associated in our experimental reference collection with the cutmarks produced by denticulates, and observed on some of the remains from the archaeological site of Grotte du Noisetier, indicates the possible use of these tools in the course of the butchery activities that took place at this site. Some of the technological and functional aspects of denticulates found in Middle Palaeolithic contexts are still debated (see, for example Geneste *et al.*, 1997; Bourguignon *et al.*, 2004; Thiébaud, 2005). However, at several sites they have been found in association with abundant faunal remains, sometimes belonging almost exclusively to a single animal species. This was notably the case at Mauran, La Borde and Puycelci, sites for which the faunal spectrum is mainly dominated by large bovids (*Bison priscus* or *Bos primigenius*; Jaubert *et al.*, 1990; Farizy *et al.*, 1994; Rendu *et al.*, 2012, 2013; Griggo unpublished in Rendu *et al.*, 2013), suggesting the use of these tools for butchery. This hypothesis is also supported by the use-wear analysis of the lithic assemblages at Les Fieux and Mauran, which indicates that the majority of denticulates were used for butchery activities, in particular: bone scraping, the cutting up of the carcasses, defleshing and disarticulation (Thiébaud *et al.*, 2012; Gerbe *et al.*, 2014). At Grotte du Noisetier, the active parts of the denticulates were not well preserved enough to allow any firm interpretations regarding their function (see Part II, chapter 2.2). However, the use-wear marks observed on four unretouched flakes and a pseudo-Levallois point from this site are typical of the action of cutting soft to medium-hard material, almost certainly corresponding to butchery activities such as defleshing or the cutting up of the carcass.

We unsuccessfully applied the method developed by M. Domínguez-Rodrigo *et al.* (2009) and used by others (de Juana *et al.*, 2010; Yravedra *et al.*, 2010), which combines a microscopic analysis of cutmarks at low resolution using an optical microscope with a multivariate statistical approach, to analyze an experimental sample, composed of cervid long bones defleshed using unretouched pieces and Mousterian tools. Indeed, no statistically significant difference could be identified between the marks produced by the unretouched pieces and those produced by the tools with the retouched edges. In addition, significant overlap in the morphology of the cutmarks was observed for the three types of tools considered. The results of this study also highlight the difficulties that arise when applying this method to the fossil record, especially when the lithic tool kit used for butchery and found in association with the faunal remains includes a wide variety of possible material (unretouched flakes, retouched flakes and various tools), as is the case for most of the Middle and Upper Palaeolithic rock shelters. Denticulates have produced arrangements of cutmarks that appear to be exclusively associated with these tools, and which have been identified both on the bones of the experimental reference collection and on certain red deer remains from the archaeological site of Grotte du Noisetier. However, more work is needed to confirm these observations, as it is not currently possible to exclude that other tools such as side scrapers, which were also potentially used during butchery, could produce arrangements of cutmarks similar to those produced by denticulates. Finally, this study highlights the need to incorporate other elements when it comes to determining the function of the lithic tools and documenting the butchery *chaîne opératoire*; in particular, use-wear data on the tools as well as the observations made during experimental butchery, which allow us to test the effectiveness of diverse lithic tools for carrying out different butchery activities, for example the cutting up of carcasses, skinning, defleshing, disarticulation, and bone fracturing in order to extract the bone marrow.

3 - Summary

(S. Costamagno, M.-C. Soulier)

Particularly difficult to identify on archaeological material (Morel, 2000; Letourneux, Pétillon, 2008), impact marks related to the use of Mousterian weapons have not been documented at any of the sites in the corpus. During the analysis of the experimental reference collection, although we did not systematically look for impact marks made by projectile weapons on the carcasses, we did observe some notches on the ribs. In view of the low number of marks attributable to the use of lithic points as hunting weapons at the sites from the corpus, the use of wooden spears or wooden points to slaughter the different game is a possible hypothesis. We can question the marks that these wooden weapons or projectile points, which are softer than lithic points, might have left on the bones. It is difficult to obtain information on the way in which the prey was acquired solely from observing the marks present on the bones. Nevertheless the zooarchaeological studies carried out at the different sites show that the Mousterians regularly hunted ungulates of large to small size (from bison to roe deer). Mesofauna was rarely hunted by Neanderthals, although a golden eagle and a falcon may have been hunted at Les Fieux and Grotte du Noisetier (Laroulandie *in* Mourre *et al.*, 2007). At some sites, the faunal spectrum is diverse: Saint-Césaire Egpf (bovines, horse and reindeer), Payre (red deer, bovines and horse). At others, one type of game dominates but other species were also hunted, for example at Les Fieux – Kdenticulate or Chez-Pinaud – US 06/07 where bison accounts for respectively 60 % (Gerbe *et al.*, 2014) and 67 % (Jaubert *et al.*, 2008) of the faunal spectrum. Red deer is the preferred prey at Grotte du Noisetier (Costamagno, 2013). At Mauran (David, Farizy, 1994) and Coudoulous 1 (Coumont, 2006) with the bison, and at Les Pradelles with the reindeer (Costamagno *et al.*, 2006, 2017), we are faced with highly-specialized faunal spectra. These three sites are also characterized by restricted hunting seasons: the end of the warm season

at Mauran and Les Pradelles (Rendu *et al.*, 2011) and late spring / early summer at Coudoulous 1 (Brugal, David, 1993). We can also add the site of Les Fieux (Kdenticulate) where only bison was hunted in winter and early spring, while red deer and horse were hunted in late summer and early fall. These sites are considered bison kill sites or hunting camps. Located in strategic positions near the routes taken by the herds during migration and occupied regularly and seasonally, these sites have the particularity of presenting a remarkable topography that was put to full use:

- A sinkhole at Coudoulous 1 and Les Fieux, which the herds could be driven into and trapped in;
- The foot of the cliff at Mauran, where bison could be cornered;
- The collapsed karst gallery for butchering reindeer carcasses at Les Pradelles, to avoid too much pressure from carnivores during the processing of the acquired resources (Costamagno *et al.*, 2017).

At Saint-Césaire, data on slaughter seasons is limited, but one slaughter season has been documented in winter and one in late winter / early spring. In Payre, the data implies relatively short residential camps, distributed throughout the year (Rivals *et al.*, 2009).

On all the sites, bone marrow was a widely sought-after resource, as demonstrated by the systematic fracturation of long bones. The only exception to this is Mauran, where several complete long bones have been documented: the quantity of resources acquired during these hunting episodes must have been such that it allowed the Neanderthals to mainly exploit the richest resources (Farizy *et al.*, 1994). This particularity is also well documented at Palaeoindian bison kill sites (e.g. Speth 1983). At Coudoulous 1 too, not all the bone marrow was retrieved as the phalanges were not fractured. At this site, the under-representation of the metapodials and phalanges is thought to reflect a rejection of these skeletal parts and could thus imply the under-exploitation of certain skeletal elements (Coumont, 2006). At Les Pradelles, which is not a kill site unlike the two previous sites, the decision was made prior to butchery, as only the richest parts were taken into the gallery, where they were then systematically fractured to retrieve the bone marrow (Costamagno *et al.*, 2006, 2017). At all the other sites for which this data is available, including Les Fieux, the phalanges were frequently fractured. This focus on bone marrow was sometimes accompanied by the removal of the grease contained in the spongy tissue such as at Les Pradelles and Grotte du Noisetier (Costamagno, 2013; Costamagno, Rigaud, 2014). At Saint-Césaire, the scarcity of the spongy tissue is more likely related to the use of these parts as fuel (Morin, 2004).

With regard to the initial stages of butchery aiming at retrieving the external resources of the carcasses (hide, offal, tongue, meat, and tendons), the data is tenuous, as the bones presented a poor surface condition at most sites (Les Fieux, Coudoulous 1, Mauran, Payre), thus limiting the analysis of butchery marks. Furthermore, with the exception of the reindeer fleshy long bones in level Egpf at Saint-Césaire (Soulier, Morin, 2016) and the bison bones at Mauran (David, Farizy, 1994), no bone collection has been subject to a cutmark report. In most cases, only the activities are mentioned, without any description of the related marks, the only exception being Coudoulous 1, for which we have proposed a reinterpretation of the marks based on the T&H reference collection. At this site, the 27 remains with butchery marks present mainly defleshing marks (*Hs-a*, *Rs-a*, *Fs-a*, *Ts-a*, *Cal-i*). There are also very occasional marks corresponding to disarticulation (*Fp-a*, *Tal-c*, *Ses-a*). Cutmarks present on the distal end of the proximal phalanx (not documented in the T&H reference collection, but also observed at Les Pradelles) reflect the disarticulation of the proximal and mesial phalanges. Other cutmarks recorded near the articular extremities and interpreted as disarticulation marks (Coumont, 2006) could just as easily result from defleshing activities (*Hd-b*, *Hd-g*, *Up-d*, *Cal-a*). Finally, short cutmarks present on two metatarsal diaphysis fragments, which have been interpreted as related to tendon removal, could just as well be due to skinning. At Mauran, the cutmarks mostly involve oblique defleshing marks (David, Farizy, 1994: 189, fig. 104): *Hs-a*, *Rs-a*, *Up-b*, *Fs-a*,

Ts-a, *Ts-c*, *Ts-e*. On the tibia, the longitudinal cutmarks present on the anterior (*Ts-e*) and lateral (*Ts-b*) faces could be due to skinning. Signs of disarticulation are rare: cutmarks present near the olecranon fossa of the humerus (*Hd-g*) could indicate that the elbow was disarticulated, but this type of cutmark could also have been produced by defleshing. On the metacarpals, the oblique cutmarks recorded on the anterior surface (*Mcs-c*) could reflect the removal of the tendons, but their length and relative distance from the groove lead us to favour the hypothesis of skinning. At Saint-Césaire, mainly oblique defleshing cutmarks are documented on the medial diaphyses of all the fleshy long bones (*Hs-a*, *Rs-a*, *Fs-a*, *Ts-a*, *Ts-b*, *Ts-c*). At this site, reindeer presents more frequent cutmarks than bison.

While defleshing is attested at all the sites, other activities are rarely discussed beyond the sites we have studied: evisceration marks are reported at Les Fieux, as well as skinning marks on a red deer metatarsal and a bison skull and mandible. The removal of the tongue is also attested at Les Fieux by the presence of a cutmark on the lingual surface of a bison mandible level with the third molar. Scraping marks observed on a European ass tibial diaphysis fragment have been interpreted as a possible indication of late meat removal (Gerbe *et al.*, 2014).

The detailed study of the butchery marks, such as it was conducted at Grotte du Noisetier and Les Pradelles, shows the full potential of this type of analysis, as it allows activities to be identified which often go unnoticed in zooarchaeological studies, as well as beginning to allow discussion on the different skills and expertise involved. In this context, the question of whether or not the tendons were removed is particularly informative, both in terms of the function of the sites and the requirements of the groups. At a kill site or primary butchery site, the objective would generally have been to retrieve the desired resources as quickly as possible, so it is unlikely that this type of cutmark would be recurrently observed, as tendon removal takes time. If the group required this material, the metapodials were highly likely to have been transported with the upper leg to then be processed by members of the group who were not participating in the hunt. At Grotte du Noisetier, for example, the site appears to have been occupied for relatively short periods of time, but the diversity of the activities carried out on the carcasses implies a group that was not solely composed of hunters. This is supported by the presence of Neanderthal deciduous teeth at the site (Maureille *et al.*, oral com.).

This division of tasks between different members of the group is even more evident at Les Pradelles. At this site, which was only occupied for a short period of time (Meignen *et al.*, 2007), reindeer carcasses were intensively butchered in parallel with the hunting and primary butchery carried out at the nearby kill site (Costamagno *et al.*, 2017). The abundance of cutmarks related to tendon removal provides an additional argument in favour of the hypothesis that some of the acquired resources were transported to another site (Costamagno *et al.*, 2006). The systematic analysis of the cutmarks further supports this hypothesis by demonstrating that fillets were removed to be dried for later consumption. At Mauran, the under-representation of the fleshiest parts also implies that they were transported to another site (Rendu *et al.*, 2011). This intentional planning of butchery activities implies a logistic model long regarded as unique to Anatomically Modern Humans. At the same time, both at Les Pradelles and Grotte du Noisetier, the use of tendons broadens the range of animal resources exploited by Neanderthals. Generally used to make ties, this material implies a technical element, even if we cannot exclude the possibility that some of the tendons were removed for food consumption (Stefansson, 1913). At Les Pradelles, the tendons of the anterior and posterior faces of the metatarsals were removed, which was not the case at Grotte du Noisetier, where the cutmarks relating to this stage of butchery reflect the almost exclusive removal of the anterior tendon of the metacarpals in all three of the levels analyzed. These differences reflect the different methods and/or different requirements of these two Neanderthal groups. At Les Pradelles, given the abundance of remains, skin removal methods can be discussed

(see Part II, chapter 3.1). Once there is more data, it should be possible to identify skin removal patterns in relation to the different sites.

In addition to the tendons and skin, bone material was also used for technical purposes. Although deer antlers never appear to have been used, bones were sometimes exploited. This is notably the case at Les Pradelles, where several hundred retouchers have been documented, principally made from reindeer long-bone diaphysis fragments (Costamagno *et al.*, 2017). At Coudoulous 1, three retouchers were found. At Grotte du Noisetier, over the entire sequence, 53 retouchers on bovine and red deer bone were documented. At the same time, splintered pieces and retouched fragments were observed (Oulad el Kaïd, 2016). While at Les Pradelles, these retouchers are sometimes associated with scraping to prepare the surface, at the other sites this preparation has not been observed.