

Human and Hyena Co-occurrences in Pleistocene sites: Insights from Spatial, Faunal and Lithic Analyses at Camiac and La Chauverie (SW France)

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Abstract: In several caves, lithic artifacts or human-modified bones have been found as more or less associated with large faunal assemblages accumulated by cave hyenas. Even if these small records remain often hard to interpret, they are essential to understand interactions between human groups and other cave dwellers. Their study can bring new elements of discussion on critical issues such as the intensity of competition for shelter occupation or the potential existence of specific human activities in hyena dens (e.g. scavenging of meat scraps, collecting of bones). Here we present an interdisciplinary work on two Upper Pleistocene hyena dens, Camiac and La Chauverie, where a small number of Middle Paleolithic artifacts have been found. Results are provided by the combination of three disciplines: faunal taphonomy, lithic analyses (including studies of reduction sequences) and spatial analysis (three-dimensional plotting, systematic refitting). At Camiac and La Chauverie, our interdisciplinary analysis highlights two distinctive types of human occupations. Sites that first seem to be closely related (hyena dens with scarce lithic artifacts) hide in fact a variety of situations, ranging from the succession of independent occupations of human groups and hyenas to potential traces of short human visits to hyena dens. Finally, by comparing our results with the regional record, we discuss the actual evidence for competition for shelter between cave hyenas and the last Neanderthals in southwestern France.

Keywords: HYENA DENS, SPATIAL ANALYSIS, TAPHONOMY, STONE TOOLS, LATE MIDDLE PALEOLITHIC, SOUTHWESTERN FRANCE, COMPETITION FOR SHELTER, NEANDERTHAL

Introduction

In the European record, small quantities of lithic artifacts have been found in several caves in stratigraphic association with large faunal assemblages accumulated by cave hyenas. The exact significance of such subtle human presence has fueled many debates regarding the nature of human-hyena relationships and the subsistence behavior of past human groups (e.g. Brugal & Jaubert, 1991; Stiner, 1994; Diez Fernandez-Lomana *et al.*, 1998; Villa & Soressi, 2000; Rosell & Blasco, 2009; Rosell *et al.*, 2010). Interpretation of these tiny records varies: they have been suggested to either reflect an overlap in the use of space resulting in a competition for shelter between the two large predators, correspond to episodic visits of hyena dens by humans for scavenging purposes (“controlled”/“active” scavenging of meat scraps cf. Brugal & Jaubert, 1991), or indicate accidental associations due to post-depositional processes (Villa & Soressi, 2000).

This debate is particularly important for the late Middle Paleolithic of southwestern France. According to recent palaeoecological works, hyenas were flourishing in this region as a consequence of an important increase in the ungulate biomass during the first half of the MIS 3 (Discamps, 2011). At this time period, Neanderthals and hyenas depended on the same prey, mainly bison and horse, and competition for food was potentially important (Discamps, *op. cit.*; Discamps *et al.*, 2011). However, the degree of interactions between these two predators and their level of competition for shelter remain unclear. This is a crucial point for palaeoecological reconstructions because humans and hyenas share a common interest in karstic cavities. In this study, we propose to tackle this issue with an interdisciplinary analysis of two sites (Camiac and La Chauverie) that includes

spatial, faunal and lithic data, in order to clarify the importance and nature of interactions between the last Neanderthals and cave hyenas with which they shared their territory.

The Camiac and La Chauverie sites

Camiac and La Chauverie are two sites from southwestern France (Figure 1) that date back to the late Middle Paleolithic, around 60 to 40 ka cal. BP, according to the recently obtained radiocarbon dates (Figure 2, Table 1).

Camiac site (Camiac et Saint Denis, Gironde) consisted of a small collapsed cave that was quickly excavated in the 1973-1974 winter by M. Lenoir, just before the site was destroyed by quarrying activities (Lenoir, 1980, 1983, 1990). Of the four lithological layers, only one (“couche D”) contained archaeological and paleontological remains (Lenoir, 1990). Despite the salvage nature of the excavations, three-dimensional

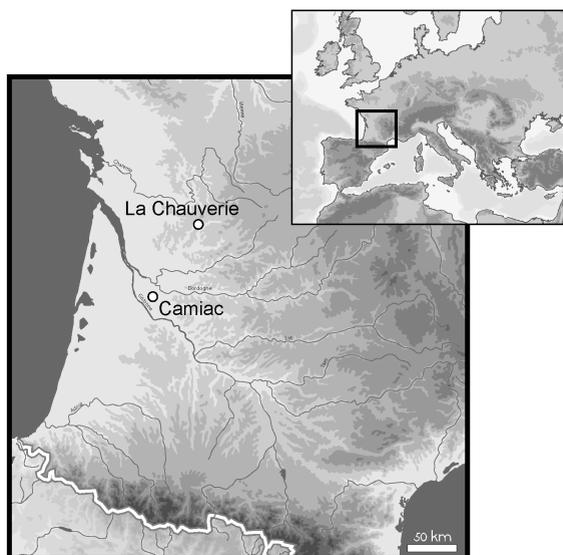


Figure 1. Location of the Camiac and La Chauverie sites.

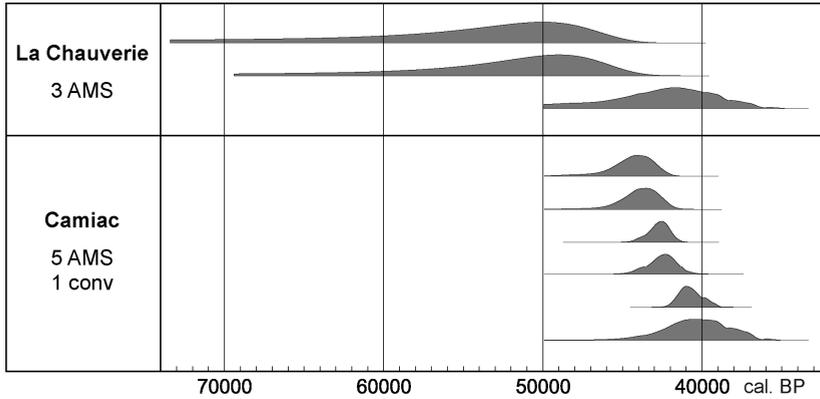


Figure 2. Radiocarbon dates for La Chauverie and Camiac calibrated using the IntCal09 curve and OxCal 4.1.

| Site | Code | Date | $\delta^{13}\text{C}$ | Taxa | Ref. |
|----------------------------------|-----------|--------------|-----------------------|----------------|------|
| La Chauverie (central sector) | OxA-23693 | 49000 ± 3400 | -17.8 | Reindeer | 1 |
| | OxA-10480 | 36700 ± 3100 | -20.8 | <i>Bovinae</i> | 2 |
| | OxA-24096 | 50000 ± 3900 | -19.6 | <i>Bovinae</i> | 1 |
| Camiac | OxA-23087 | 35600 ± 700 | -19.86 | Megaceros | 1 |
| | OxA-23088 | 38000 ± 900 | -19.05 | Megaceros | 1 |
| | Ly-6981 | 40000 ± 1600 | unreported | Horse | 1 |
| | Ly-6982 | 37600 ± 1200 | unreported | Rhinoceros | 1 |
| | Ly-6983 | 39400 ± 1500 | unreported | <i>Bovinae</i> | 1 |
| | Ly-1104 | 35100 ± 2000 | unreported | - | 3 |

Table 1. List of the radiocarbon dates for Camiac and La Chauverie (all AMS except Ly-1104). 1: Discamps, 2011; 2: Tournepiche et al., 2005; 3: Lenoir, 1980.

coordinates were recorded for most remains on field logs, and when not piece-plotted, remains were marked by their square number. The sediment was not sieved. Even though some analyses had already been undertaken on the lithic and faunal remains in the past (Lenoir, 1980, 1983, 1990; Guadelli, 1987, 1989; Guadelli *et al.*, 1988), basic data was still missing, thus justifying a full reappraisal of the material with new methodologies that include lithic technology, faunal taphonomy and spatial analysis. The data presented here results from our revision of the Camiac collections.

La Chauverie site (Ronsenac, Charente) mainly consists of a network of open-air ducts (Figure 3). Excavations were first run by J.F. Tournepiche in 1999 and then from 2003 to 2006 (Tournepiche, 2004; Tournepiche & Ferrier, 2004; Tournepiche *et al.*, 2005). Several lithostratigraphic units were initially distinguished in some sectors of the site, but their distinction was not always possible on the field (Tournepiche *et al.*, 2005). Thus, large quantities of material could not be attributed to a given lithostratigraphic unit. The quality of the record varies according to the excavated sectors: deposits are much less rich in material

in some parts of the cavity (e.g. “sud” sector) and have been reworked by badger activities in others (e.g. “connexion” sector). So far, among the different sectors, only the “central” one has provided abundant material in a presumably preserved sequence of deposits. In this sector, a total station was used to record the three-dimensional coordinates of remains more than 3 cm in length and the sediment was water-sieved. We will focus here on the results acquired in this “central” sector.

Excavations of these two sites revealed abundant faunal material presumably mostly accumulated by cave hyenas (Camiac: n = 2526; Chauverie central sector: n = 1225) and a small number of stone tools (Camiac: n = 186; Chauverie central sector: n = 54), with a similar ratio of between four and seven lithics for one hundred faunal remains. Both

sites present the major advantage that artifacts were piece-plotted in three dimensions, a procedure that allows full spatial analysis of the deposits.

General Methodology

The interdisciplinary approach undertaken here has been designed for apprehending interactions between humans and hyenas. This can only be achieved if one is able to distinguish the different phases of occupation, to reconstruct the type of occupation (i.e. site function), and the chronology of these occupations.

At Camiac and la Chauverie, a precise distinction of occupation levels was not possible in the field. However, the recording of three-dimensional coordinates permits

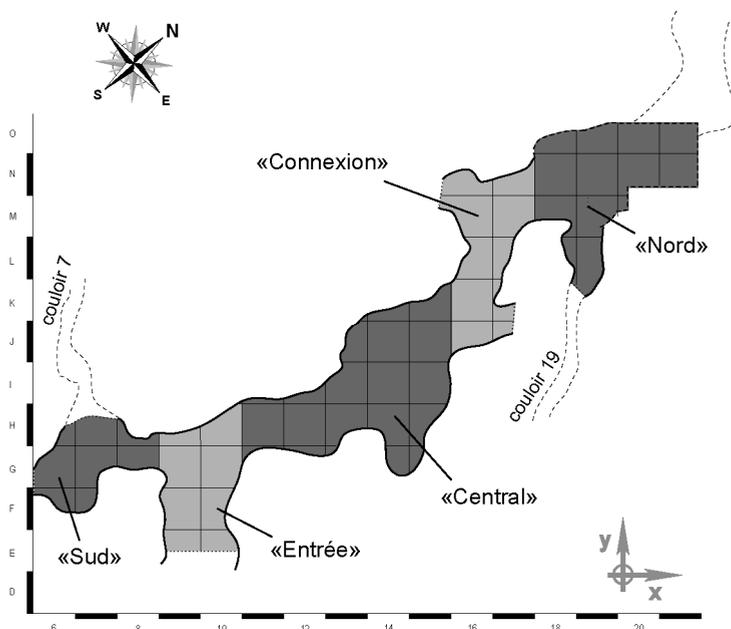


Figure 3. Zenithal map of the La Chauverie site showing the different sectors excavated.

distributional analyses and subdivision of the assemblages into distinct levels after excavation. Three-dimensional spatial analyses allow for the chronology of cave occupations by humans and hyenas to be more accurately reconstructed compared to what is possible to observe during fieldwork. The resolution acquired is then limited only by excavation methods and the resolution of the stratigraphic record. In this context, the goal is to distinguish coherent assemblages that are defined by their archeological or paleontological composition rather than their lithostratigraphic characteristics. This approach is essential to fully understand multilayered sites. It aims to establish subdivisions of the deposits on different criteria (e.g. lithostratigraphy, archeostratigraphy, biostratigraphy) that are independent from each other (e.g. the geological layers do not necessarily correspond to the archeostratigraphic assemblages, cf. Texier, 2000; Delpech, 2007). It also permits the homogeneity and integrity of deposits to be discussed, and can, in certain cases, complement data acquired through geological analyses of site formation processes (e.g. Bordes, 2002; Mallye, 2007).

This type of approach is still rarely applied to Paleolithic sequences, even if it has shown great potential for the analysis of occupational sequencing in multilayered archeological sites (e.g. Cahen, 1976; Villa, 1976, 1982, 2004; Schiffer, 1983; Villa & Courtin, 1983; Schick, 1986; Enloe, 1991; Hofman & Enloe, 1992; Le Grand, 1994; Lacrampe-Cuyaubère, 1996, 1997; Audouze & Enloe, 1997; Bordes, 2002; Beauval, 2005; Morin *et al.*, 2005; Mallye, 2007, 2011; Michel, 2010; Bachellerie, 2011; Enloe, 2011; Aubry *et al.*, 2012; Rosell *et al.*, 2012). Relying on the methodologies previously developed in this large body of works, spatial analysis is here carried out in three main steps:

- The general spatial organization of the remains is first described with three-dimensional plots (zenithal, frontal and sagittal projections) and density histograms. Plots were realized on the three dimensions, with a projection thickness of 50 cm for cross-sectional plots. Hence, they represent *in fine* several dozens of figures that cannot be presented individually here: in this paper, only key examples and summarized plots are provided (while all the other plots are accessible in Discamps, 2011).
- The spatial distribution of key features is analyzed through GIS. Numerous complementary criteria are investigated, for example type of material (fauna, stone tools, coprolites), species identifications or taphonomic alterations of cortical surfaces (e.g. black deposits, concretions).
- Post-excavation assemblages are identified based on results from the first two steps.

The relevance of these assemblages is then assessed through the systematic search of refits for all identified faunal fragments, within and between layers. The three-dimensional plotting of these refits allows us to discuss the existence of chronological and behavioral links between different levels or sectors of the sites. Mechanical refitting (matching of fracture edges of two fragments of the same bone) is considered more robust (Figure 4). Thus, articular reconstructions and pairings are not included, except for the articular reconstructions made on horse upper cheek teeth (Figure 5). For these teeth, especially abundant at Camiac (MNE = 105), the anterior and posterior contact surfaces are sufficiently large for articular reconstructions to be established with a high level of confidence, especially when reconstructions are combined with other criteria (occlusal outline, wear stage, crown shape).

Spatial analysis is realized with the DataDesk™ and ArcGIS (© ESRI) software suites, programs that can be easily tuned to efficiently process archeological spatial data (e.g. Lacrampe-Cuyaubère, 1996, 1997). The spatial, faunal and lithic databases are all connected using a unique identification number for each remain.

Only the most relevant results of the paleoecological and taphonomic studies of the faunal material are presented here (for more details, see Discamps, 2011). Pieces, including shaft fragments, were identified at the most precise level possible with their skeletal and specific attribution. Cortical surfaces have been observed under a low-angled light using a 20x hand lens and a stereomicroscope when judged necessary. Carnivore and human modifications were recorded alongside several other taphonomic alterations (root etching, concretions, abrasion, dissolution, weathering, black deposits).

At both sites, the lithic assemblages have been analyzed according to three main criteria: edge alteration, raw material petrographic and sourcing characterization, techno-typological attributes. The technological composition of the assemblages has been compared with a database being established from knapping experiments based on core reduction strategies (Brenet *et al.*, 2009) similar to those evidenced at Camiac and La Chauverie (respectively discoidal and Levallois *debitages*). The aim was to precise which stages of the reduction sequences were present on site and which site function related to stone tool processing may be inferred.

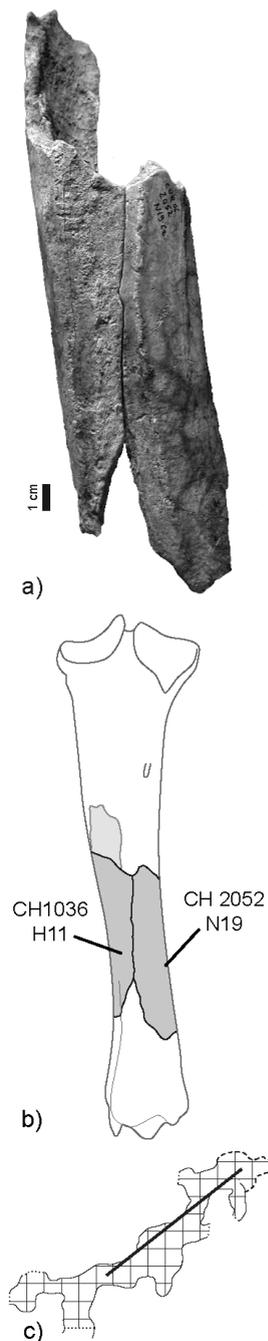


Figure 4. Example of a mechanical refit between two shaft fragments of a Bovinae tibia from La Chauverie (a), with the anatomical positioning of the two fragments (b), and the resulting inferred connection on a zenithal map of the site (c).

Distinction of occupational levels

La Chauverie

At La Chauverie, two concentrations of faunal material can be distinguished:

- In the northern part of the central sector, the distinction of the two concentrations is relatively easy on cross-sectional plots, thanks to the presence of a thin sterile layer (Figure 6).
- In other sectors, this sterile layer is less apparent, but the two concentrations are still distinguishable through the use of density histograms (Figure 7), even if they are not clearly visible at first on the section plots.

- Complete coprolites are abundant and well preserved at the bottom of the sequence while they are mostly absent in the upper part of the deposits (Figure 6, 7).

- The distinction of these two assemblages is validated by the spatial analysis of the bone refits. All refits are intra-assemblage (Table 2), most of them are nearly horizontal, and the two assemblages seem coherent (Figure 8).

The existence of two layers does not, however, necessarily imply that two phases of occupation of the site are documented. Two layers can indeed result from the action of post-depositionnal processes, such as solifluction (Texier, 2000). Two lines of evidence suggest that the identified assemblages do in fact represent two successive phases of occupations:

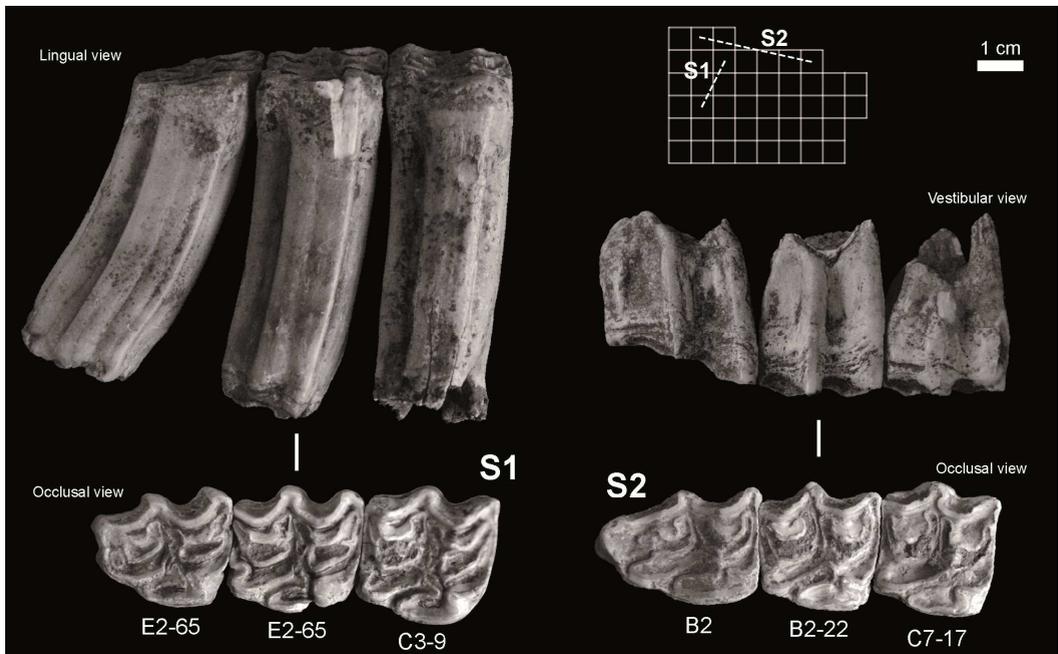


Figure 5. Examples of articular reconstructions between horse upper cheek teeth at Camiac. Top right: resulting inferred connections on a zenithal map of the site.

- Clear differences appear in the spatial distribution of some species. If Bovinae are dominant in the two assemblages, red deer, European ass and wild boar remains are concentrated in the lower assemblage, while reindeer, especially rare in the bottom layer (3% of the herbivore total NISP), represent nearly one quarter of the faunal remains in the upper assemblage (22% of the herbivores, Figure 9). These differences in species composition are statistically significant: reindeer is seven times more abundant in the upper assemblage ($\chi^2 = 60.717$; $p < 0.01$) and red deer two times more frequent in the lower one ($\chi^2 = 4.784$; $p < 0.05$).

- Besides, differences in taphonomic alterations also exist between the two layers. As an example, in the northern part of the central sector, black deposits are nearly twice more frequent in the upper assemblage (Figure 10). There are highly significant statistical differences between the upper and lower assemblages in the proportion of bones affected by concretions ($\chi^2 = 23.346$; $p < 0.01$), black deposits ($\chi^2 = 91.918$; $p < 0.01$) and weathering ($\chi^2 = 30.18$; $p < 0.01$).

If two faunal assemblages can be distinguished at La Chauverie, the same is not true for lithic artifacts. Stone tools are scattered in the site with no clear concentrations (Figure 11), and both assemblages include a comparable small number of artifacts (26 in the lower assemblage, 28 in the upper one). This could indicate successive brief visits of human groups or repetitive isolated contamination by post-depositional processes.

Camiac

At Camiac, only one homogenous bone layer exists:

- The faunal remains consist apparently of a single layer that dips to the east by about 10

degrees (Figure 12). It is not possible to distinguish any concentration corresponding to occupational levels, even if the remains are much more scattered in the northern part of the site.

- Some remains are identified as “ceramic fragments?” in the field manuals. It was not possible for us to verify those identifications, because these materials could not be found in the collections. The “ceramic fragments?” are concentrated in the northern part of the site, where the deposits are less dense (*cf. supra*). The northern part of the site may consist of reworked deposits.

- Concretions are much more abundant in the southern part of the site (Figure 13). However, this spatial configuration does not seem to reveal the existence of different occupational levels; the abundance of concretions might be due to the proximity to the drip line. The spatial distribution of taphonomic features is not always a good tool for the distinction of assemblages.

Mechanical refits and articular reconstructions on faunal material are abundant and several of them connect distant sectors of the site, both horizontally and vertically (Figure 14). In this manner, they seem to fit well with the hypothesis of a single bone assemblage where no stratigraphic distinction can be done. The potential reworked sector, at the north, is also connected by several refits with the southern portion of the site.

These characteristics preclude any division of the faunal assemblage, as it seems to be homogenous, even though some parts of the deposits might have been reworked.

The spatial distribution of lithic artifacts is much more informative. If only one bone assemblage can be identified, stone tools seem to be concentrated at the base of the sequence (Figure 12). This could be explained by the existence of a previous human

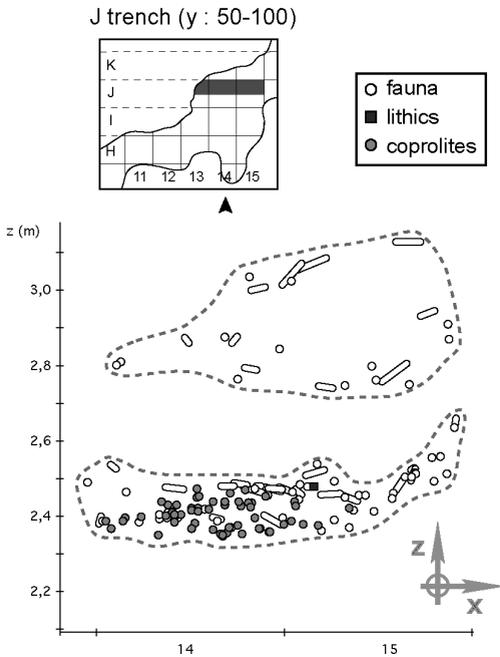


Figure 6 (left). Example of the subdivision of deposits with the use of cross-sectional plots (La Chauverie). In these squares, a sterile layer is clearly visible around an elevation of 2.6-2.7 m and the complete coprolites are concentrated at the bottom of the sequence.

occupational layer that was subsequently mixed with the faunal material of a hyena den.

Faunal taphonomy

For the two bone assemblages of La Chauverie and the one from Camiac, all the taphonomic criteria point to a nearly exclusive accumulation of bone remains by hyenas:

- Hyena is relatively frequent in the three assemblages (Figure 9): it accounts for 16% of identified specimens in the lower assemblage of La Chauverie (NISP 71), 12% in the upper assemblage (NISP 44) and 6.6% at Camiac (NISP 80).
- Juveniles (stages I and II of Brugal *et al.*, 1997) are quite common in both hyena populations (MNI 4 out of 15 for La Chauverie, MNI 3 out of 7 for Camiac).

H11 square

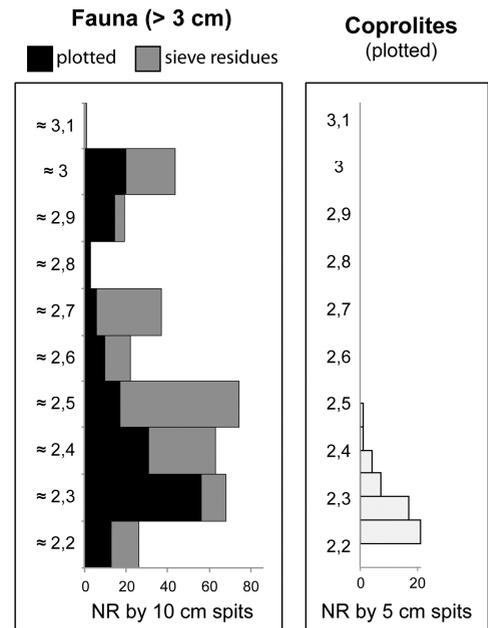
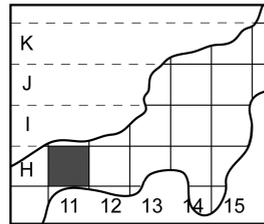


Figure 7. Example of the subdivision of deposits only made possible through the use of density histograms (La Chauverie). In this square (H11), even if there is no sterile layer, the density of faunal remains is much more important around 3 m and 2.3-2.5 m. Complete coprolites are concentrated at the bottom of the sequence.

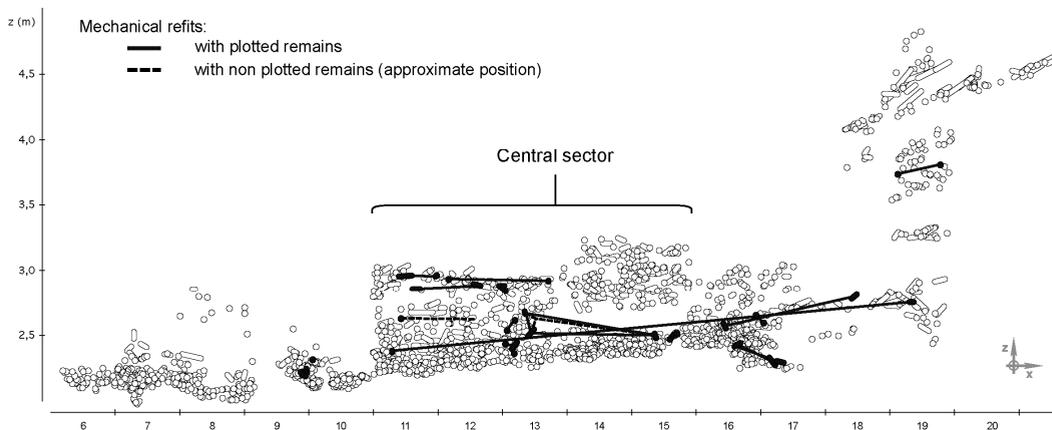


Figure 8. Representation of faunal refits on a sagittal projection (La Chauverie).

- Complete coprolites are frequent at Camiac (even if they were not plotted). At La Chauverie, they are abundant, either in well-preserved forms (in the lower assemblage, with over 700 complete coprolites) or in the sieve residues (in the upper assemblage, where only 3 coprolites are complete while fragments are plentiful).
- Carnivore modifications are abundant, in the form of tooth marks, digested bones and teeth both at Camiac (30% of the total number of remains have tooth marks; 10% are digested) and at La Chauverie (lower assemblage: 18% tooth marked, 42% digested; upper assemblage: 17% tooth marked, 28% digested). These numerical values are quite similar to what is documented in recently excavated hyena dens (e.g. Villa *et al.*, 2004; Beauval & Morin, 2010).

Even though post-depositional processes affected part of the assemblages (such as limited weathering, root etching or concretions), the bone conservation is excellent at both sites. At Camiac, 88% of the remains have cortical surfaces sufficiently well preserved so that they can be considered as “observable” for zooarcheological

analyses. At La Chauverie, when the abundant small fragments with digested surfaces (42% of the remains in the lower assemblage and 28% in the upper one) are excluded, this percentage varies from 80% (lower assemblage) to 84% (upper assemblage) of the total remains. Despite this excellent preservation of cortical surfaces, traces of human activity on the faunal material are extremely rare at Camiac (NISP 9, 0.4% of the remains with observable surfaces) while totally absent in the central sector of La Chauverie.

Thus, at La Chauverie, there are no evident link between faunal remains and stone tools: they were likely entirely accumulated by different agents (*i.e.* hyenas and humans).

At Camiac, it would be tempting to correlate the presence of the few human-modified faunal remains with the occupation documented by the stone tools. However, the human-modified bones are not spatially associated with the lithic artifacts (Figure 15); they are even most abundant in squares where stone tools are absent, as in C2 and F1. Considering this absence of spatial correlation between stone tools and human-modified

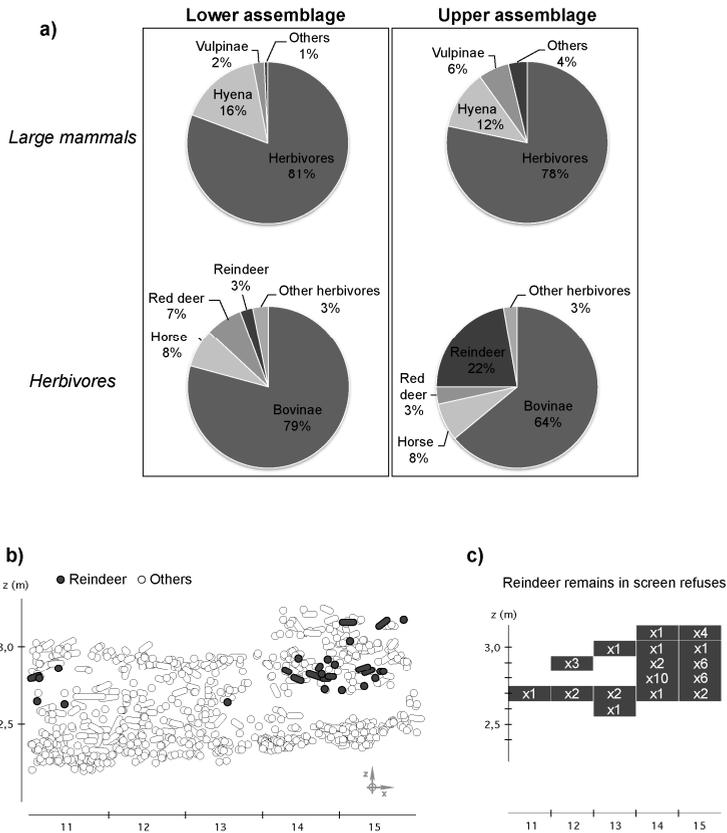


Figure 9. Repartition of identified species at La Chauverie. Pie charts (%NISP) for the lower and upper assemblages (a). Distribution of Reindeer fragments in the central sector, on a sagittal projection for plotted remains (b), and according to their approximate position in the sequence for those found in sieve residues (c).

| Faunal refits | Central sector - lower assemblage | Central sector - upper assemblage | Other sectors |
|-----------------------------------|-----------------------------------|-----------------------------------|---------------|
| Central sector - lower assemblage | 13 | 0 | 1 |
| Central sector - upper assemblage | | 5 | 0 |
| Other sectors | | | 13 |

Table 2. Number of faunal mechanical refits between the different assemblages and sectors at La Chauverie.

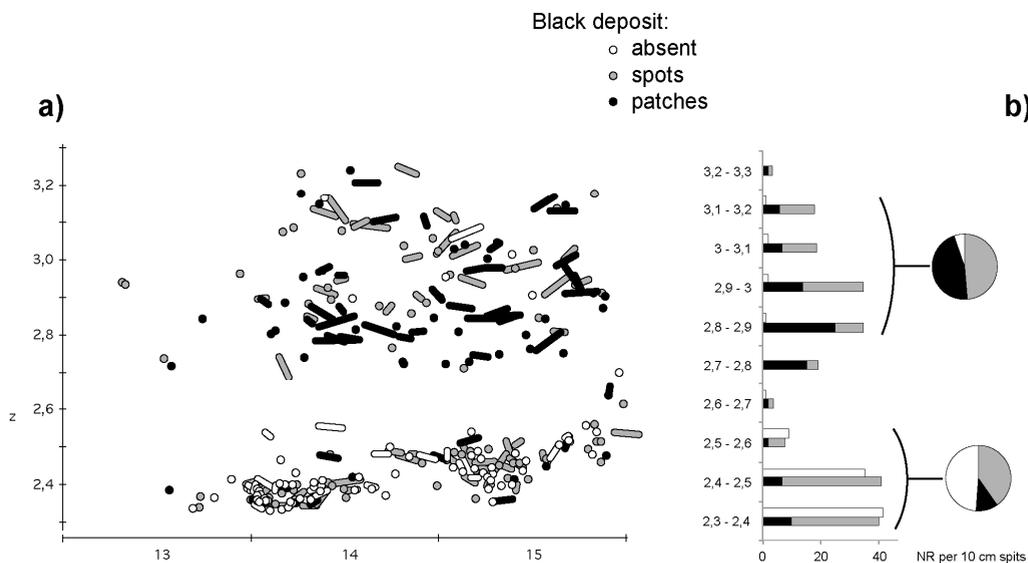


Figure 10. Distribution of faunal remains with black deposits at La Chauverie on a sagittal projection (a) and by 10 cm spits (b). Differences are visible between the lower part (bottom pie in b) and the upper part (top pie in b) of the deposits.

remains, it would be possible to interpret these few remains as the result of scavenging by hyenas of a distant human camp, in the event that hyenas brought back to their den bones that were previously processed by humans. However, from the nine remains concerned, two of them seem to have been used to retouch stone tools (Figure 16). One of these retouchers (bottom of Figure 16) is particularly convincing: it bears two clear utilized zones, with an intensive previous scraping of the cortical surface. These types of modifications imply that the bone fragment certainly had lost most of its nutritious value when discarded by humans (Vincent, 1993; Mallye *et al.*, 2012). Thus, contamination by scavenging seems highly unlikely. These retouchers could indicate a distinct human occupation, different from the one documented by the stone tools.

Lithic analyses

Important additional lines of evidence are brought by the analysis of stone tool industries, even if they are quite rare in both sites (especially at La Chauverie). Most of the material is attributable to the late Mousterian.

At La Chauverie, the artefacts are diagnostic of the Mousterian of Acheulean Tradition, with a debitage system that follows the principles of the Levallois unidirectional method, together with a small number of bifaces (Figure 17, Table 3).

At Camiac, if we exclude the few blade fragments, the assemblage is entirely devoted to the production of discoidal flakes, with a variety of short and thick end-products, encompassing pseudo-Levallois points, backed flakes and flakes with multidirectional removals (Figure 18, Table 3).

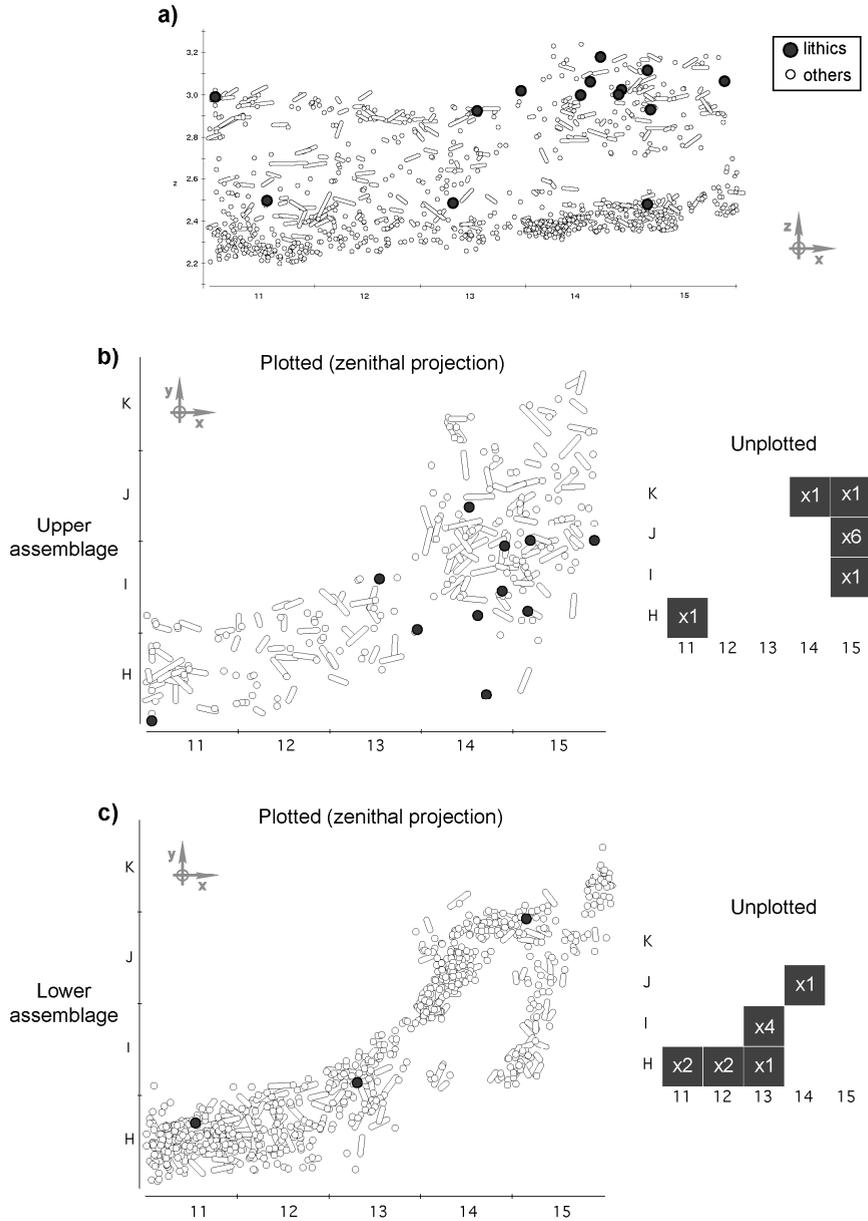


Figure 11. Distribution of stone tools found at La Chauverie on a sagittal projection (a, plotted only), and on zenithal maps for the upper (b) and lower (c) assemblages (plotted and unplotted).

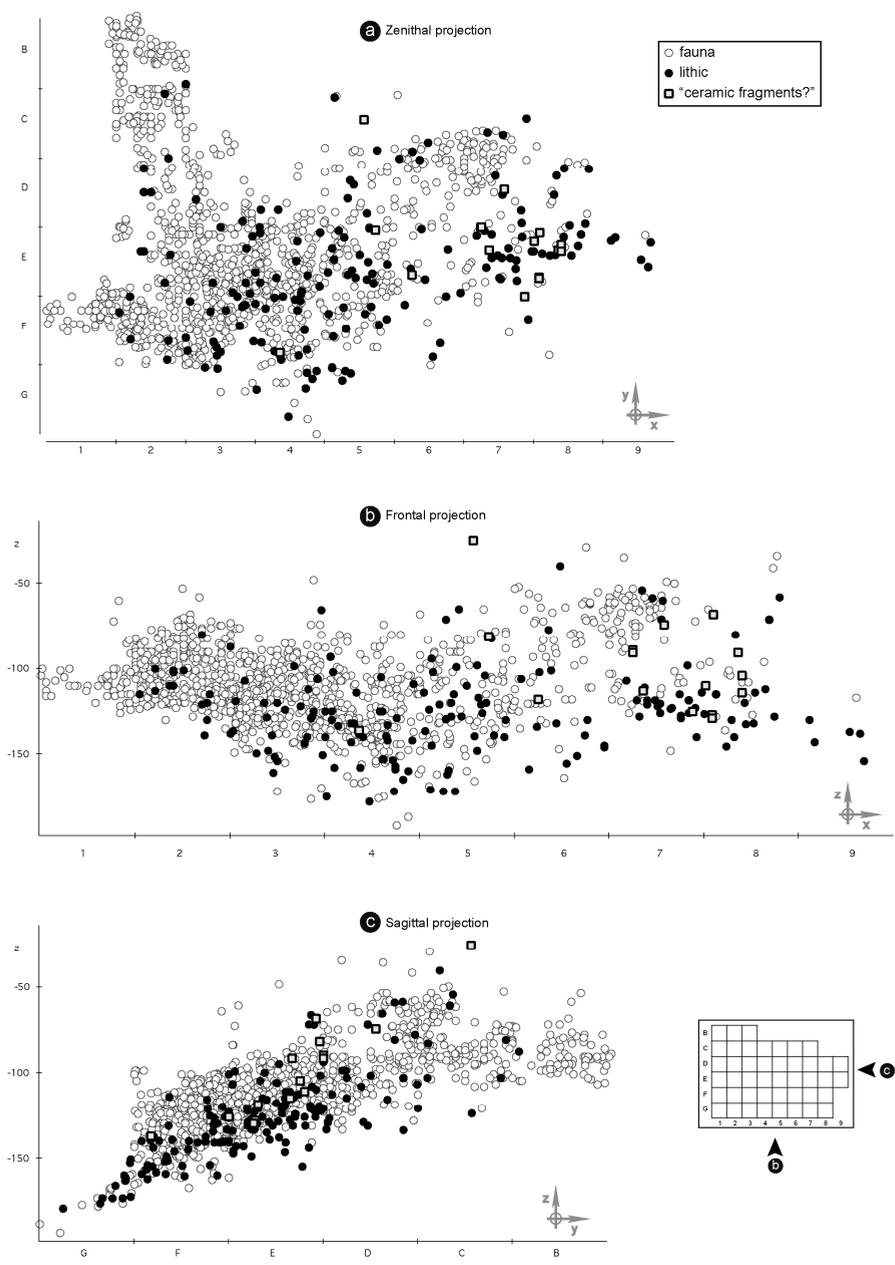


Figure 12. Distribution of plotted artifacts at Camiac on zenithal (a), frontal (b) and sagittal projections (c). Bottom right: schematic representation of the frontal and sagittal views on a zenithal map of the site.

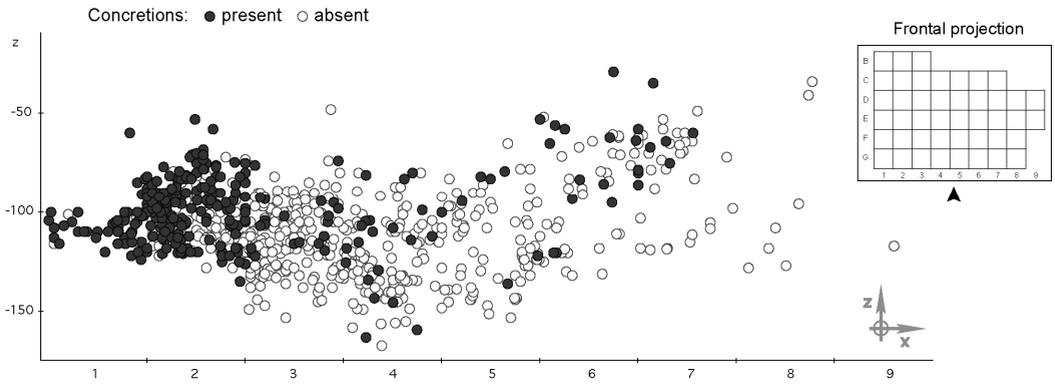


Figure 13. Distribution of faunal remains with concretions at Camiac on a frontal projection.

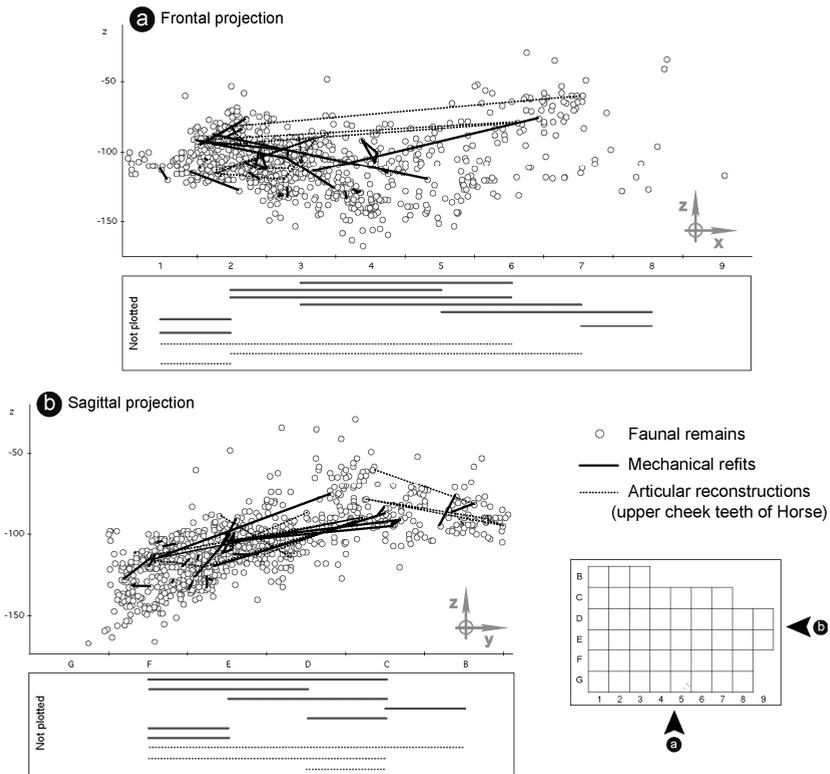


Figure 14. Representation of faunal refits (Camiac) on frontal (a) and sagittal views (b). Refits between plotted finds are figured on projections (top a, top b), while the ones made between unplotted remains are figured on schematic graphs (boxes at the bottom of a and b).

The retouched tools are mostly scrapers and notches.

In both sites, lithic material does not show any edge abrasion, suggesting that massive displacement of the stone tools is unlikely, contrary to Bois Roche as documented by Villa & Soressi (2000). However, micro-removals on the edges are frequent (present on 48% of the elements at Camiac; 86% at La Chauverie), but it is still unclear whether this is related to utilization, trampling or limited post-depositionnal transport.

Concerning raw material provenience, the two series are clearly dissimilar. At La Chauverie, 69% of the stone tools are made

of a range of non-local flints issued from varied sources, more than 15 km distant from the site to the north, west and south (Figure 19). At Camiac, locally available flints, issued from the adjacent Dordogne riverbed, are largely predominant (98%). They exhibit cortical surfaces that are typical of an alluvial transport.

Analyses of reduction sequences bring interesting insights on site function. For each site, the proportions of the main components of reduction sequences (cortical flakes, core preparation flakes, flakes and cores) are compared in Figure 20 with experimental debitage (Brenet *et al.*, 2009),

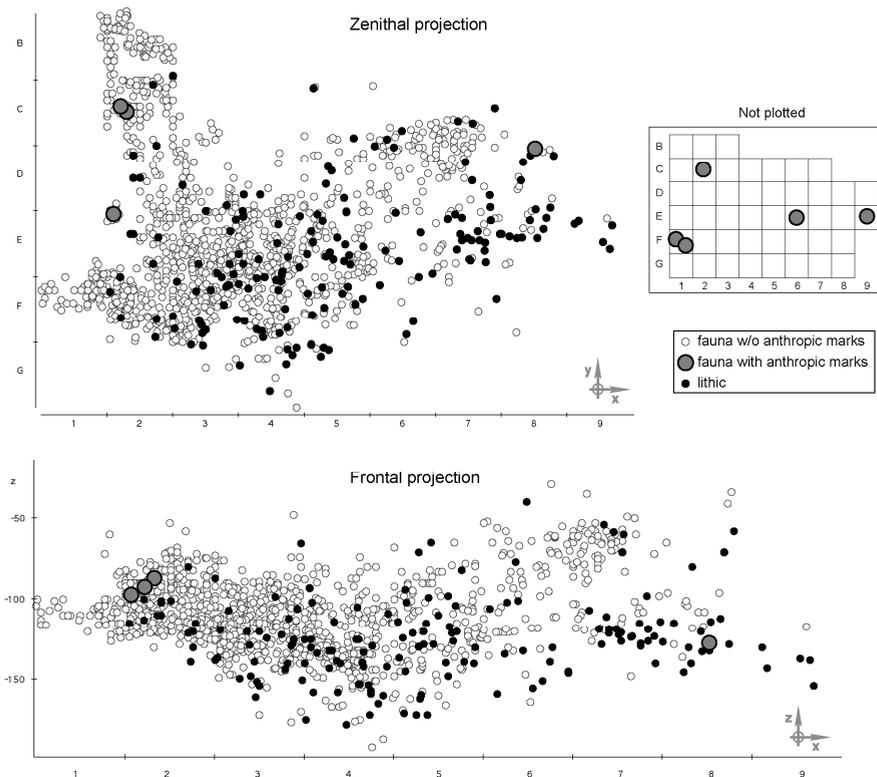


Figure 15. Distribution of plotted human-modified bone remains and lithic artifacts at Camiac (zenithal and frontal projections).

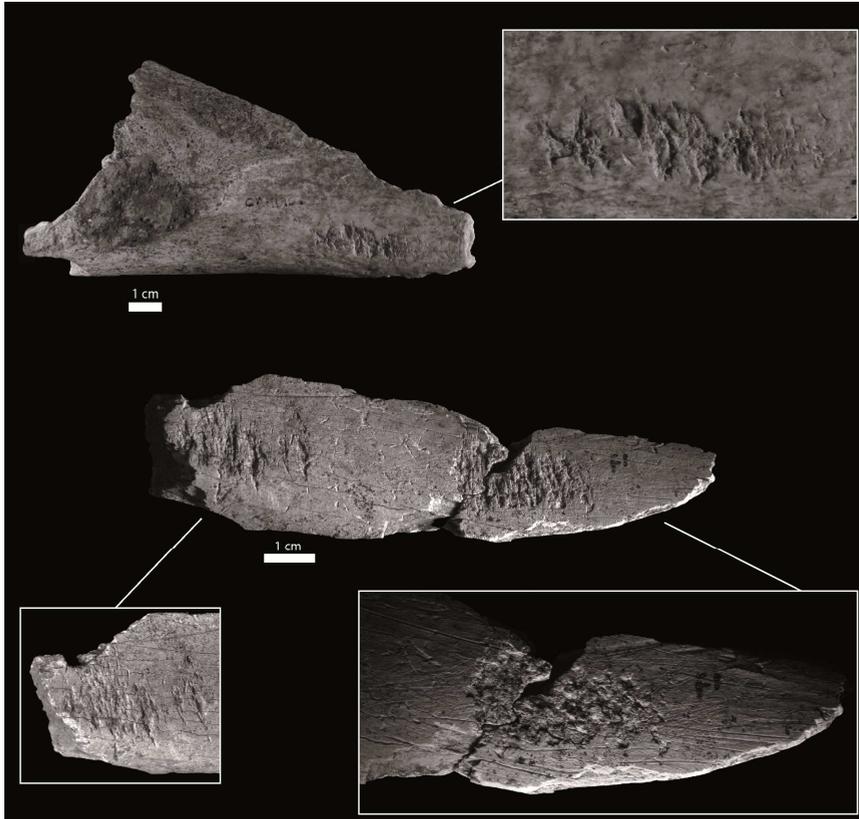


Figure 16. Possible retouchers from Camiac.

performed with similar debitage methods (Levallois for La Chauverie and discoidal for Camiac).

The composition of the lithic assemblage at La Chauverie evidences segmented reduction sequences. The final stages of the “chaîne opératoire” (tool use and discard) are over-represented, while the initial stages (core preparation and production) have likely been mostly performed elsewhere. The lithic items represent the personal gear of individuals who arrived at the site with a small number of end-products that have been used and then abandoned on site.

These products have sometimes been resharpened, recycled or flaked on site and discarded. The retouched tools on flakes and the bifaces correspond for most part to broken or recycled tools, likely abandoned because of their exhaustion (Figure 17). La Chauverie was likely used as a stop over for mobile groups of hunter-gatherers.

The composition of the lithic assemblage at Camiac is highly similar to the composition of the experimental dataset. Flake production was carried out on site. The whole reduction sequence was performed on site, from core preparation to tool use

and discard, which suggests that the site was used as a living place during an episode of human occupation. The cores are slightly over-represented: this may have resulted from the transport of part of the end-products out of the site.

Thus, clear differences can be highlighted in the site function of Camiac and La Chauverie.

Discussion and conclusion

Interpreting traces of human presence in hyena dens

At first glance, Camiac and La Chauverie seem to be highly similar sites, with large faunal assemblages accumulated by hyenas associated with a small number of lithic artifacts. However, the results of our interdisciplinary analyses show that this type of site hides a diversity of past scenarios.

Camiac comprised a succession of occupations in the same locus by humans and hyenas, respectively as a living place and as a den. In this scenario, successive occupations of a given site by humans and hyenas are “mixed”, either because there were not distinguished during excavations or as a result of post-depositional processes (including the burrowing activity of hyenas themselves, cf. Stiner, 1994). This scenario seems to apply to Camiac, but also to Les Rochers de Villeneuve (Beauval, 2005; Beauval & Morin, 2010), Brassempouy (Letourneux, 2003), Tournal (Magniez, 2009, 2010), Portel Ouest (Gardeisen, 1994) and Les Plumettes (Beauval & Morin, 2010).

The human presence in hyena dens may also consist of shorter occupations. La Chauverie includes faunal assemblages

presumably entirely accumulated by hyenas with a few stone tools that seem to represent brief human visits into or in the vicinity of the den.

Nevertheless, the presence of traces of human activity in hyena dens does not necessarily imply that humans ever visited the den or met the hyenas. At Bois Roche, P. Villa and M. Soressi (2000) highlighted a quite different story where stone tools are only present in the hyena den due to important post-depositional transport from outside the cave. This may also be the case of Artenac layer 10 (Delagnes *et al.*, 1999). Furthermore, traces of human presence can also result from contamination due to the scavenging by hyenas of a distant anthropogenic site. This can explain the presence of human-modified bones when hyenas bring back to their dens carcasses already processed by humans (Costamagno *et al.*, 2005), or even stone tools if hyenas brought back meat scraps with enched projectile points (at least for the Upper Paleolithic). Actually, anthropogenic sites are rarely exempt of evidence of carnivore activity (Chase *et al.*, 1994). However, as a counter-argument, carnivore scavenging on anthropogenic accumulations is more likely to have occurred directly on site (as documented by Blumenschine, 1988): the transport of human-modified bones from anthropogenic sites to hyena dens is thus a hypothetical scenario.

These few examples show how hyena dens with traces of human presence may correspond to a large array of past histories. The distinction of these different scenarios is a prerequisite for any discussion on human-hyena interactions. It can be achieved through an interdisciplinary approach that confront 3D spatial data with the results of faunal and lithic studies (as shown here for Camiac and

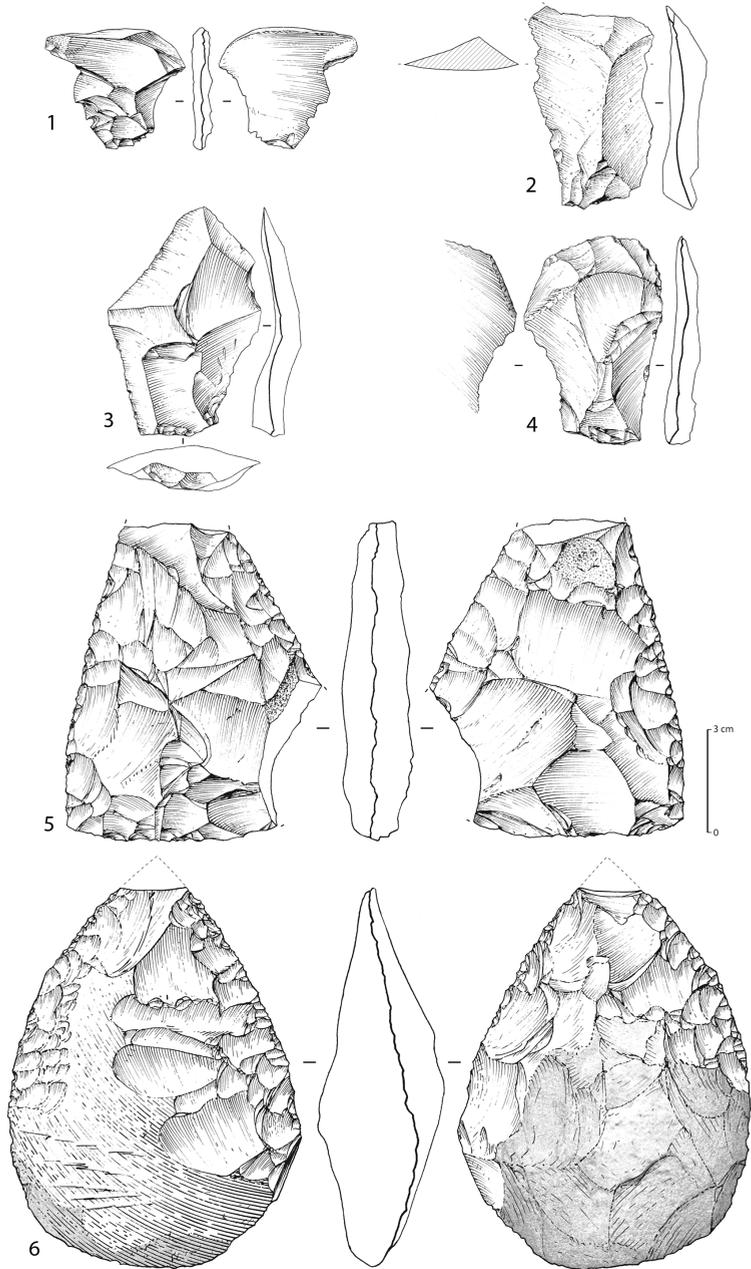


Figure 17. Lithic artifacts from La Chauverie (1: shaping flake; 2 to 4: Levallois flakes; 5: broken and recycled biface; 6: broken biface). Drawings by Gauthier Devilder.

La Chauverie), but also with geoarcheological analyses when they are available (they are still in progress for La Chauverie).

Competition for shelter: where do we stand?

Regarding the importance of competition for shelter between humans and hyenas, a few key points should be reminded:

1) Examples of successive occupation of the same cave by humans and hyenas are plentiful, a fact that highlights the partial overlap between the two predators in their habitat needs. Every hyena den from this time period and in this region has, to some extent, yielded traces of human presence, in the form of:

- stones tools (e.g. Camiac and La Chauverie; Plumettes and Rochers de Villeneuve, cf. Beauval & Morin, 2010; Unikoté, cf. Michel, 2004; Bois Roche, cf. Villa & Soressi, 2000; Artenac, cf. Delagnes *et al.*, 1999; Fontéchevade, cf. Chase *et al.*, 2009; Tournal, cf. Tavoso, 1987; Portel Ouest, cf. Prince *et al.*, 2005; Gerde, cf. Clot, 1987; Trou du Cluzeau, cf. Tournepiche *et al.*, 1995; Brassempouy, cf. Bon, 2002);
- and/or human-modified bones (e.g. Camiac; Plumettes and Rochers de Villeneuve, cf. Beauval & Morin, 2010; Unikoté, cf. Michel, 2004; Bois Roche, cf. Villa *et al.*, 2004 and Bourdillat, 2008; Fontéchevade, cf. Paletta, 2005 and Chase *et al.*, 2009; Tournal, cf. Magniez, 2009, 2010; Portel Ouest, cf. Gardeisen,

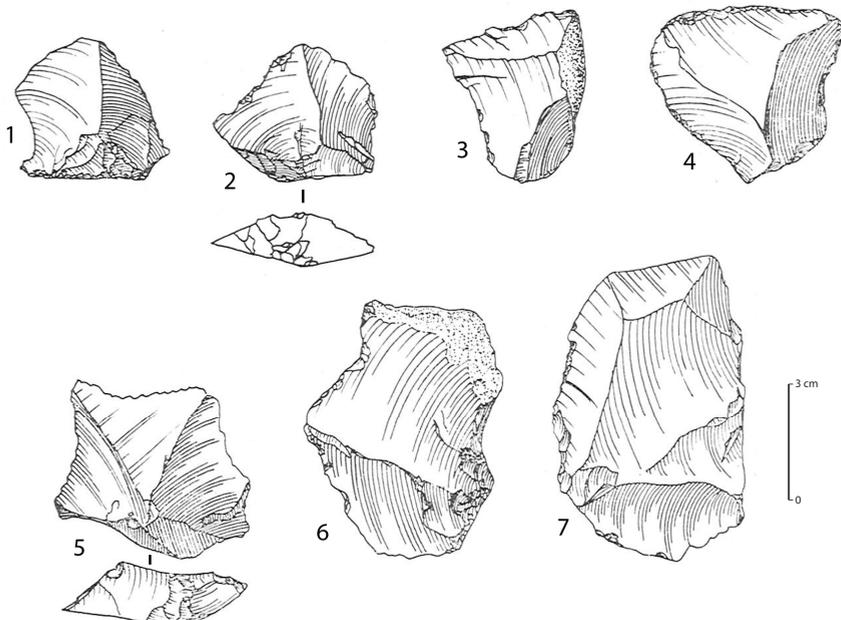


Figure 18. Lithic artifacts from Camiac (1 to 7: discoidal flakes). Drawings by Michel Lenoir.

1994; Brassempouy, cf. Letourneux, 2003; Conives, cf. Fourvel, 2008) with, in few cases, a small number of burnt bones (e.g. at Plumettes, Rochers de Villeneuve, Fontéchevade, Tournal, Portel Ouest and Brassempouy). The interpretation of such a record is however often tricky and it does not always imply any interaction between humans and hyenas (cf. *supra*; Villa & Soressi, 2000).

2) Hyenas and men did not favor exactly the same type of cave, especially when roof height is considered, as shown in Moscerini and

Guattari caves (Stiner, 1994). Nevertheless, if two predators occupied the same karstic system, encounters were likely to happen even if they did not inhabit exactly the same caves or part of the caves. Competition for shelter cannot be rejected on this sole argument, as differences in roof height preferences probably did not facilitated cohabitation between hyenas and hominids.

3) Carnivore consumption of Neanderthals remains is documented in a few sites: some bones bear clear tooth marks, as in Rochers de Villeneuve (Beauval *et al.*, 2005) or Grotte

| | Camiac | La Chauverie (central area) |
|--|------------|--------------------------------|
| Lithic categories (including tools) | | |
| Whole/broken pebbles | 1 | 1 |
| Hammerstones | 2 | 1 |
| Worked pebbles | 1 | 0 |
| Cortical flakes | 42 | 5 |
| Flakes with a cortical back | 13 | 0 |
| Flakes | 24 | 9 |
| Debordant flakes/pseudo-Levallois points | 37 | 0 |
| Multidirectional flakes | 8 | 0 |
| Core management flakes | 0 | 8 |
| Levallois flakes | 0 | 13 |
| Cores | 12 | 0 |
| Bifaces | 0 | 1 |
| Flakes < 2 cm | 33 | 10 |
| Chunks | 13 | 6 |
| TOTAL | 186 | 54 |
| Tools | | |
| Scrapers | 19 | 1 |
| Notches | 3 | 0 |
| Endscraper | 1 | 0 |
| « Pièce esquillée » | 1 | 0 |
| Retouched tools | 4 | 0 |
| Châtelperron point | 0 | 1 |
| TOTAL | 28 | 2 |

Table 3. Composition of the lithic assemblages from Camiac and La Chauverie.

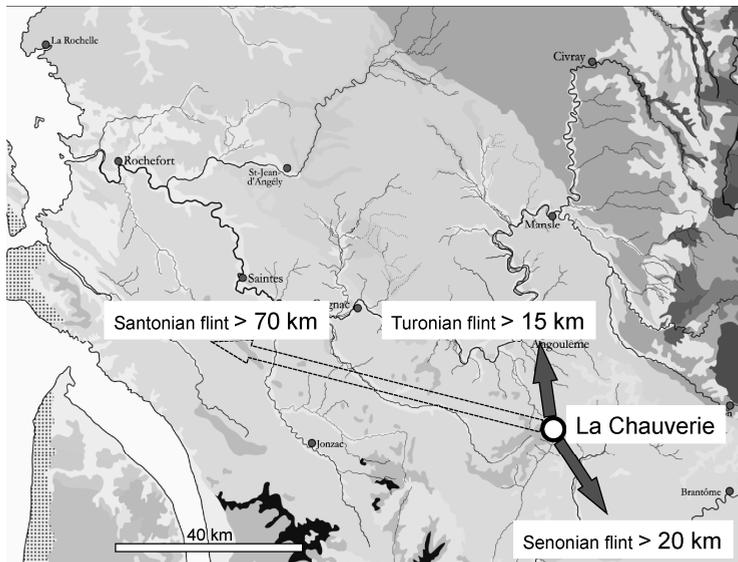


Figure 19. Raw material proveniences for La Chauverie lithics.

du bison (David *et al.*, 2009), and human teeth are sometimes found digested, as in Rochelot cave (Tournepiche & Couture, 1999). This could suggest direct confrontation between Neanderthals and hyenas or scavenging of human corpses by hyenas. Modern spotted hyenas are indeed known for digging up human graves (Horwitz & Smith, 1997). Hyena bones bearing cutmarks are also known in the French late Middle Paleolithic (e.g. David & Poulain, 1990), and even in southwestern France at Rochers de Villeneuve (Beauval, pers. comm.). These rather exceptional remains are reliable evidence that Neanderthals and hyenas were strictly contemporaneous in the same territory, and thus encounters seem highly likely.

In addition to the fact that hyenas are extremely abundant in southwestern France during the late Middle Paleolithic (Discamps, 2011), these key points permit to consider that competition for shelter between

Neanderthals and hyenas is likely, but yet unproven. Indeed, the very low temporal resolution of terrestrial records limits detailed discussions on the interactions between humans and carnivores in the caves. In most cases, the temporal factor remains poorly known: it is always difficult to estimate if occupations by humans and hyenas of a same site are separated by a few days, months, years or centuries. Few exceptions exist, for example when a single bone shows a superposition of carnivore and human modifications. These extremely rare pieces can sometimes provide indication of the timing of occupations (e.g. Bourdillat, 2008; Blasco & Rosell, 2009) but they correspond to epiphenomena.

Our discussion of human-hyena interactions is greatly biased by the available record: it is possible that most of the encounters and interactions between the two predators do not happened in caves,

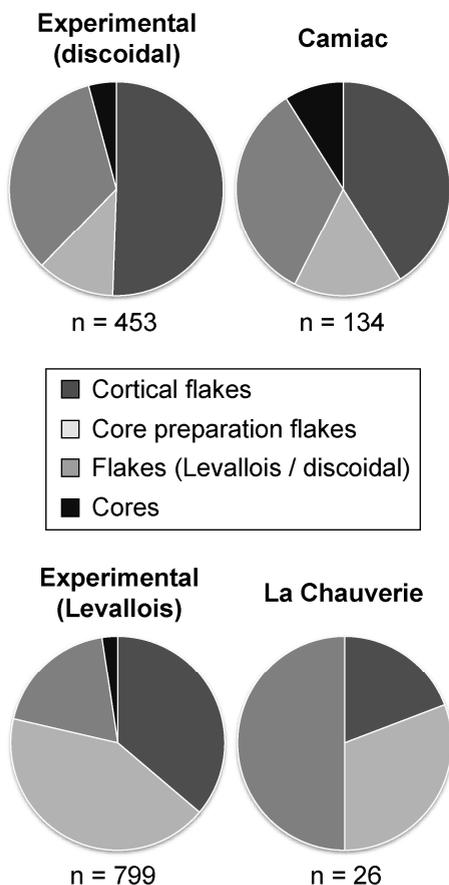


Figure 20. Comparisons between experimental debitage and the lithic assemblages of Camiac and La Chauverie (according to the proportions of the main components of reduction sequences).

but rather in open-air sites next to freshly killed carcasses, under sedimentary conditions unfavorable for the preservation of faunal remains. A large part of the “theatre” is thus missing. This is even more probable when considering that, as M. Stiner (1994:152) pinpointed, «it is more likely [that humans and hyenas] responded opportunistically to

the prospect of clean, empty shelters of suitable dimensions and setting. Each would have avoided caves already taken up by predators, the cheapest strategy in a landscape full of holes».

If no final answer can be given, the strict contemporaneity between the two predators (as evidenced by consumption traces) and their shared interest in the use of karstic cavities (as evidenced by successive occupations of the same caves) support the idea that competition for shelter between Neanderthals and hyenas is probable during the late Middle Paleolithic in southwestern France.

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References

- Aubry, T., Dimuccio, L.A., Almeida, M., Buylaert, Fontana, L., Higham, T., Liard, M., Murray, J.P.S., Neves, M.J., Peyrouse, J.B. & Walter, B. (2012). Stratigraphic and technological evidence from the middle palaeolithic-Châtelperronian-Aurignacian record at the Bordes-Fitte rockshelter (Roches d'Abilly site, Central France). *Journal of Human Evolution*, 62 (1): 116-137.
- Audouze, F. & Enloe, J.G. (1997). High resolution archaeology at Verberie: limits and interpretations. *World Archaeology*, 29 (2): 195-207.
- Bachellerie, F. (2011). *Quelle unité pour le Châtelperronien? Apport de l'analyse taphonomique et techno-économique des industries lithiques de trois gisements aquitains de plein-air: le Basté (Pyrénées-Atlantiques), Bidart (Pyrénées-Atlantiques) et Canaule II (Dordogne)*. PhD dissertation, Université Bordeaux 1.
- Beauval, C. (2005). *Les Rochers de Villeneuve, Lussac-les-Châteaux, Vienne, Triennale 2001-2003, Document Final de Synthèse*. SRA Poitou-Charentes.
- Beauval, C. & Morin, E. (2010). Les repaires d'hyènes du Lussacois (Lussac-les-Châteaux, Vienne, France). Apport des sites des Plumettes et des Rochers de Villeneuve, In (Buisson-Catil, J. & Primault, J., eds.) *Préhistoire entre Vienne et Charente. Hommes et sociétés du Paléolithique*. Association des Publications Chauvinoises, Chauvigny, pp. 175-190.
- Blasco, R. & Rosell, J. (2009). Who was the first? An experimental application of carnivore and hominid overlapping marks at the Pleistocene archaeological sites. *Comptes Rendus Palevol*, 8 (6): 579-592.
- Blumenschine, R.J. (1988). An experimental model of the timing of hominid and carnivore influence on archaeological bone assemblages. *Journal of Archaeological Science*, 15 (5): 483-502.
- Bon, F. (2002). *L'Aurignacien entre mer et Océan. Réflexion sur l'unité des phases anciennes de l'Aurignacien dans le Sud de la France*. Mémoires de la Société Préhistorique Française, Paris.
- Bordes, J.G. (2002). *Les interstratifications Châtelperronien/Aurignacien du Roc de Combe et du Piage (Lot, France): analyse taphonomique des industries lithiques, implications archéologiques*. PhD dissertation, Université Bordeaux 1.
- Bourdillat, V. (2008). *Hommes-Carnivores? Caractériser l'action de l'hyène des cavernes: De l'utilisation des données fossiles pour l'interprétation des sites mixtes*. PhD dissertation, Muséum National d'Histoire Naturelle de Paris.
- Brenet, M., Bourguignon, L., Folgado, M. & Ortega, I. (2009). Élaboration d'un protocole d'expérimentation lithique pour la compréhension des comportements techniques et techno-économiques au Paléolithique moyen. *Les Nouvelles de l'Archéologie*, 118: 60-64.
- Brugal, J.P., Fosse, P. & Guadelli, J.L. (1997). Comparative study of bone assemblages made by recent and Pleistocene Hyenids, In (Hannus, L.A., Rossum, L. & Winham, R.P., eds.) *Proceedings of the 1993 bone modification conference Hot Springs*, South Dakota, pp. 158-187.
- Brugal, J.P. & Jaubert, J. (1991). Les gisements paléontologiques pléistocène à indices de fréquentation humaine: un nouveau type de comportement de prédation ? *Paléo*, 3: 15-41.
- Cahen, D. (1976). Nouvelles fouilles à la pointe de la Gombe (ex pointe de Kalina), Kinshasa, Zaïre. *L'Anthropologie*, 80 (4): 573-602.
- Chase, P.G., Armand, D., Debénath, A., Dibble, H. & Jelinek, A.J. (1994). Taphonomy and zooarchaeology of a Mousterian faunal assemblage from La Quina, Charente, France. *Journal of Field Archaeology*, 21 (3): 289-305.
- Chase, P.G., Debénath, A., Dibble, H.L. & McPherron, S.P. (2009). *The cave of Fontéchevade. Recent excavations and their paleoanthropological implications*. Cambridge University Press.
- Clot, A. (1987). *La grotte de Gerde (Hautes Pyrénées): site préhistorique et paléontologique*. Société Ramond, Bagnères-de-Bigorre.
- Costamagno, S., Beauval, C., Lange-Badré, B., Vandermeersch, B., Mann, A. & Maureille, B. (2005). Homme ou carnivores ? Protocole d'étude d'ensembles osseux mixtes: l'exemple du gisement moustérien des Pradelles (Marillac-le-Franc, Charente). *Archaeofauna*, 14: 43-68.
- David, F. & Poulain, T. (1990). La faune de grands mammifères des niveaux XI et XC de la grotte du Renne à Arcy-sur-Cure (Yonne). Etude préliminaire, In (Farizy, C., ed.) *Paléolithique moyen récent et Paléolithique supérieur ancien en Europe*. APRAIF, Mémoires du Musée de Préhistoire d'Ile-de-France, 3, Nemours, pp. 319-323.
- David, F., D'Intchenko, V., Enloe, J.G., Girard, M., Hardy, M., Lhomme, V., Roblin-Jouve, A., Tillier, A. & Tolmie, C. (2009). New Neandertal remains from the Grotte du Bison at Arcy-sur-Cure, France. *Journal of Human Evolution*, 57 (6): 805-809.
- Delagnes, A., Tournepeiche, J.F., Armand, D., Desclaux, E., Diot, M.F., Ferrier, C., Le Fillâtre, V. & Vandermeersch, B. (1999). Le gisement Pléistocène moyen et supérieur d'Artenac (Saint-Mary, Charente):

- premier bilan interdisciplinaire. *Bulletin de la Société Préhistorique Française*, 96 (4): 469-496.
- Delpech, F. (2007). Le grand abri de la Ferrassie, source de réflexion sur la biostratigraphie d'un court moment du Pléistocène, *Arts et cultures de la préhistoire*. Editions du CTHS, Paris, pp. 303-314.
- Diez Fernandez-Lomana, J.C., Jorda Pardo, J. & Arribas Herrera, A. (1998). Torrejones (Tamajon, Guadalajara, Spain). A hyaena den on human occupation, In (Brugal, J.P., Meignen, L. & Patou-Mathis, M., eds.) *Économie Préhistorique : les comportements de subsistance au Paléolithique*. Éditions APDCA, Antibes, pp. 63-72.
- Discamps, E. (2011). *Hommes et hyènes face aux recompositions des communautés d'Ongulés (MIS 5-3): éléments pour un cadre paléoécologique des sociétés du Paléolithique moyen et supérieur ancien d'Europe de l'Ouest*. PhD dissertation, Université Bordeaux 1.
- Discamps, E., Jaubert, J. & Bachelier, F. (2011). Human choices and environmental constraints: deciphering the variability of large game procurement from Mousterian to Aurignacian times (MIS 5-3) in southwestern France. *Quaternary Science Reviews*, 30 (19-20): 2755-2775.
- Enloe, J.G. (1991). *Subsistence organization in the upper paleolithic: carcass refitting and food sharing at Pincevent*. PhD dissertation, University of New Mexico.
- Enloe, J.G. (2011). Middle Palaeolithic Cave Taphonomy: Discerning Humans from Hyenas at Arcy-sur-Cure, France. *International Journal of Osteoarchaeology*: doi: 10.1002/oa.1276.
- Fourvel, J.B. (2008). *Étude paléontologique et taphonomique des vestiges osseux d'une tanière d'hyène tachetée fossile (Crocota crocota spelaea) du Pléistocène Supérieur: Conives (Indre, France)*. Master 2 thesis, Université de Toulouse II Le Mirail.
- Gardeisen, A. (1994). *Restes fauniques et stratégies de chasse dans le Pléistocène supérieur de la grotte Ouest du Portel (Ariège, France)*. PhD dissertation, Université Paul Valéry.
- Guadelli, J.L. (1987). *Contribution à l'étude des zoocénoses préhistoriques en Aquitaine (Würm ancien et interstade würmien)*. PhD dissertation, Université Bordeaux 1.
- Guadelli, J.L. (1989). Étude taphonomique du repaire d'hyènes de Camiac (Gironde, France). Éléments de comparaison entre un site naturel et un gisement préhistorique. *Bulletin de l'Association française pour l'étude du Quaternaire*, 91-100.
- Guadelli, J.L., Lenoir, M., Marambat, L. & Paquereau, M.M. (1988). Un gisement de l'interstade würmien en Gironde: le gisement de Camiac à Camiac et Saint Denis, In (Binford, L. & Rigaud, J.P., eds.) *L'homme de Néandertal, vol. 4, La Technique*. Études et Recherches Archéologiques de l'Université de Liège (31), Liège, pp. 59-69.
- Hofman, J.L. & Enloe, J.G. (1992). *Piecing together the past: applications of refitting studies in Archaeology*. BAR International Series 578.
- Horwitz, L.K. & Smith, P. (1997). The taphonomy of human bones from hyaena accumulations, In (Hannus, L.A., Rossum, L. & Winham, R.P., eds.) *Proceedings of the 1993 bone modification conference Hot Springs, South Dakota*, pp. 188-194.
- Lacrampe-Cuyaubere, F. (1996). *Profil et plans de répartition de vestiges archéologiques: techniques de construction et d'analyse avec Data Desk (version 5.0 pour Macintosh)*. Master thesis, Université Bordeaux 1.
- Lacrampe-Cuyaubère, F. (1997). Utilisation du logiciel Data Desk™ pour la construction de projections de vestiges archéologiques: une application automatisée à l'usage des préhistoriens. *Paléo*, 9 (1): 335-349.
- Le Grand, Y. (1994). *Approche méthodologique et technologique d'un site d'habitat du Pléistocène moyen : la grotte n°1 du Mas des caves (Lunel-Viel, Hérault)*. PhD dissertation, Université de Provence.
- Lenoir, M. (1980). Fouilles de sauvetage dans un gisement du Pleistocène récent en Gironde : Le gisement de la cimenterie d'Espiet à Camiac et Saint-Denis (Gironde). *Revue historique et archéologique du Libournais*, XLVIII (176): 41-51.
- Lenoir, M. (1983). *Le Paléolithique des basses vallées de la Dordogne et de la Garonne*. PhD dissertation, Université Bordeaux 1.
- Lenoir, M. (1990). Le passage du Paléolithique moyen au Paléolithique supérieur dans les basses vallées de la Dordogne et de la Garonne, In (Farizy, C., ed.) *Paléolithique moyen et Paléolithique supérieur ancien en Europe*. APRAIF, Mémoires du Musée de Préhistoire d'Ile-de-France, 3, Nemours, pp. 215-221.
- Letourneux, C. (2003). *Devine qui est venu dîner à Brassempouy? Approche taphonomique pour une interprétation archéozoologique des vestiges osseux de l'Aurignacien ancien de la grotte des Hyènes (Brassempouy, Landes)*. PhD dissertation, Université Paris 1.
- Magniez, P. (2009). Taphonomic Study of the Middle and Upper Palaeolithic Large Mammal Assemblage from Tournal Cave (Bize-Minervois, France). *Journal of Taphonomy*, 7 (2-3): 203-233.
- Magniez, P. (2010). *Étude paléontologique des Artiodactyles de la grotte Tournal (Bize-Minervois, Aude, France). Étude taphonomique, archéozoologique et paléoécologique des grands mammifères dans leur cadre biostratigraphique et paléoenvironnemental*. PhD dissertation, Université de Perpignan.

- Mallye, J.B. (2007). *Les restes de Blaireau en contexte archéologique: Taphonomie, archéozoologie et éléments de discussion des séquences préhistoriques*. PhD dissertation, Université Bordeaux 1.
- Mallye, J.B., Thiébaud, C., Mourre, V., Costamagno, S., Claud, E. & Weisbecker, P. (2012). The Mousterian bone retouchers of Noisetier Cave: experimentation and identification of marks. *Journal of Archaeological Science*, 39 (4): 1131-1142.
- Mallye, J.B. (2011). Badger (*Meles meles*) Remains Within Caves as an Analytical Tool to Test the Integrity of Stratified Sites: The Contribution of Unikoté Cave (Pyrénées-Atlantiques, France). *Journal of Taphonomy*, 9 (1): 15-22.
- Michel, A. (2010). *L'Aurignacien récent (post-ancien) dans le Sud-Ouest de la France: variabilité des productions lithiques. Révision taphonomique et techno-économique des sites de Caminade-Est, l'abri Pataud, Roc-de-Combe, Le Flageolet I, La Ferrassie et Combemenué*. PhD dissertation, Université Bordeaux 1.
- Michel, P. (2004). La grotte d'Unikoté (Iholdy, Pyrénées Atlantiques, France): une grotte - repaire d'hyènes des cavernes avec des indices de présence humaine dans des niveaux würmiens. *Revue de Paléobiologie, Genève*, 23 (2): 741-760.
- Morin, E., Tsanova, T., Sirakov, N., Rendu, W., Mallye, J.B. & Lévêque, F. (2005). Bone refits in stratified deposits: testing the chronological grain at Saint-Césaire. *Journal of Archaeological Science*, 32 (7): 1083-1098.
- Paletta, C. (2005). *L'évolution des comportements de subsistance des hommes du Moustérien au Solutrénien dans la région Poitou-Charentes (France)*. PhD dissertation, Muséum National d'Histoire Naturelle de Paris.
- Prince, G., Saos, T. & Vezian, R. (2005). Le Portel Ouest, la fin des Néandertaliens? In (Tuffreau, A., ed.) *Peuplements humains et variations environnementales au Quaternaire*. BAR International Series 1352, Archaeopress, Oxford, pp. 117-126.
- Rosell, J., Blasco, F., Rivals, F., Chacón, M.G., Menendez, L., Morales, J.I., Rodriguez-Hidalgo, A.J., Cebrià, A., Carbonell, E. & Serrat, D. (2010a). A stop along the way: the role of Neanderthal groups at level III of Teixoneres Cave (Moia, Barcelona, Spain). *Quaternaire*, 21 (2): 139-154.
- Rosell, J. & Blasco, R. (2009). Home sharing: carnivores in anthropogenic assemblages of the Middle Pleistocene. *Journal of Taphonomy*, 7 (4): 305-324.
- Rosell, J., Blasco, R., Fernandez-Laso, M.C., Vaquero, M. & Carbonell, E. (2012). Connecting areas: Faunal refits as a diagnostic element to identify synchronicity in the Abric Romaní archaeological assemblages. *Quaternary International*, 252: 56-67.
- Schick, K.D. (1986). *Stone Age Sites in the Making: Experiments in the Formation and Transformation of Archaeological Occurrences*. BAR International Series 314, Archaeopress, Oxford.
- Stiner, M.C. (1994). *Honor among thieves: a zooarchaeological study of Neandertal ecology*. Princeton University Press, Princeton.
- Tavoso, A. (1987). Le remplissage de la grotte Tournal à Bize-Minervois (Aude). *Cypselà*, VI: 23-35.
- Texier, J.P. (2000). À propos des processus de formation des sites préhistoriques. *Paléo*, 12: 379-386.
- Tournepiche, J.F. (2004). *Grotte de la Chauverie (Ronsenac, Charente). Rapport de sondage*. SRA Poitou-Charentes.
- Tournepiche, J.F. & Couture, C. (1999). The hyena den of Rochelot cave (Charente, France), In (Gaudzinski, S. & Turner, E., eds.) *The role of early humans in the accumulation of european lower and middle palaeolithic bone assemblages*. Monographie des Römisch-Germanischen Zentralmuseums 42, pp. 89-101.
- Tournepiche, J.F., El Albani, A., Delagnes, A., Ferrier, C. & Park, S.J. (2005). *Grotte de la Chauverie (Ronsenac, Charente). Rapport de fouille 2005*. SRA Poitou-Charentes.
- Tournepiche, J.F. & Ferrier, C. (2004). *Grotte de la Chauverie (Ronsenac, Charente). Rapport de fouille 2004*. SRA Poitou-Charentes.
- Tournepiche, J.F., Michel, P. & Ferrier, C. (1995). *Rapport sur les fouilles effectuées au Trou du Cluzeau (Charente, campagne 1995)*. SRA Poitou-Charentes.
- Villa, P. (1976). Sols et niveaux d'habitat du Paléolithique inférieur en Europe et au Proche Orient. *Quaternaria*, 19: 107-134.
- Villa, P. (1982). Conjoinable Pieces and Site Formation Processes. *American Antiquity*, 47 (2): 276-290.
- Villa, P. (2004). Taphonomy and stratigraphy in European prehistory. *Before Farming*, 1: 1-20.
- Villa, P., Castel, J.C., Beauval, C., Bourdillat, V. & Goldberg, P. (2004). Human and carnivore sites in the European Middle and Upper Paleolithic: similarities and differences in bone modification and fragmentation. *Revue de Paléobiologie, Genève*, 23 (2): 705-730.
- Villa, P. & Courtin, J. (1983). The interpretation of stratified sites: A view from underground. *Journal of Archaeological Science*, 10 (3): 267-281.
- Villa, P. & Soressi, M. (2000). Stone tools in carnivore sites: the case of Bois Roche. *Journal of Anthropological Research*, 56 (2): 187-215.
- Vincent, A. (1993). *L'outillage osseux au Paléolithique moyen: une nouvelle approche*. PhD dissertation, Université Paris X - Nanterre.