

# ACQUISITION AND PROCESSING OF REINDEER IN THE PARIS BASIN

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**Abstract:** Reindeer hunting is clearly the focus of subsistence activities for most of the Magdalenian sites in the Paris Basin for which we have substantial faunal preservation. Sites such as Pincevent and Verberie exhibit redundant patterning in seasonality and carcass processing, indicating that fall migration interception was a strategic choice. A large portion of their economic systems was based on the planned exploitation of this single species. Patterns of exploitation of very small amounts of other species are consistent with the necessary predominance of reindeer. Nonetheless, environmental constraints probably precluded exclusive dependence on reindeer throughout the year. Food sharing patterns between occupants of Magdalenian campsites indicate close economic, social and, probably, kinship ties among these Magdalenians. On the whole, reindeer exploitation patterns in the Paris Basin appear to exhibit significant variation from those of other regions, particularly the Périgord. There also appears to have been evolution in subsistence activities reflecting climatic change at the end of the Pleistocene and adaptation by local groups during the terminal Magdalenian.

**Résumé:** Dans la plupart des sites magdaléniens du Bassin parisien livrant de la faune bien conservée, la chasse au Renne constitue la principale activité de subsistance. Des sites tels Pincevent ou Verberie livrent des schémas récurrents dans les saisons d'abattage et dans le traitement des carcasses de cette espèce. L'interception des troupeaux lors des migrations d'automne peut être considérée comme un choix stratégique des Magdaléniens du Bassin parisien. Le système économique apparaît basée, pour une large part, sur l'exploitation planifiée de cette seule ressource. L'exploitation minimale d'autres espèces est, d'ailleurs, consistante avec le rôle prédominant du Renne dans l'économie de subsistance de ces groupes. Le partage de la nourriture entre les occupants des campements magdaléniens témoignent de forts liens économiques, sociaux et sans doute familiaux. Les modes d'exploitation du Renne dans le Bassin parisien semblent montrer des variations significatives par rapport à celles d'autres régions, en particulier le Périgord. En outre, à la fin du Pléistocène, l'évolution des activités de subsistance pourrait être le reflet de l'adaptation des groupes locaux du Magdalénien final face aux changements climatiques.

## INTRODUCTION

The organization of Upper Paleolithic subsistence has often been characterized by specialized hunting, particularly of reindeer (Mellars, 1973, 1989, 1994). While this may be debatable for the early Upper Paleolithic (Enloe, 1993), very high proportions of single species are more common on archaeological sites after the last glacial maximum, particularly for the Magdalenian, although it must be noted that not all late Magdalenian sites are dominated by single species (Costamagno, 1999, this volume). The prominence of such sites in the archaeological record has probably resulted in such characteristics' being generalized for the entire Upper Paleolithic. This probably over-emphasizes contrastive models between the Middle and Upper Paleolithic, and obscures the real and complex processes of evolution through the end of the Pleistocene (Straus, 1990; Clark, 2002).

Stiner (1993: 66) questions whether predatory adaptations can be consistently distinguished on the bases of species eaten. Rather than looking only at the prey species, we must concentrate on how given species were taken, processed and consumed. Despite high proportions of bison at Middle Paleolithic sites such as Mauran (Farizy, David & Jaubert, 1994), Champlost (Brugal & David, 1993) or Coudoulous (Brugal & Jaubert, 1996), or of reindeer in early Upper Paleolithic sites such as Abri Pataud (Spiess 1979), Roc de Combe, la Gravette, le Piage (Mellars, 1989: 357) and le

Flageolet I (Enloe, 1993; Grayson & Delpech, 1998), those species were not necessarily targeted as specialized prey but were rather a reflection of species availability at particular locations or seasons. This does not appear to be the case for the late Upper Paleolithic sites in northern France. This paper documents patterns of exploitation of reindeer in the Paris Basin of northern France and contrasts it to the exploitation of other species, and suggests reasons for regional variation in the treatment of those species.

Late in the Magdalenian period many new regions were pioneered, expanding out of the heartland of the Périgord region into areas that had not been occupied during the glacial maximum. One such area is the Paris basin, settled first in the south along the Loing as Magdalenians moved up from the Loire region, then moving up into the center of the basin (Hemmingway, 1980; Schmider, 1984), occupying sites at Etiolles, Pincevent, Verberie, Marsangy and Marolles. Of the Paris Basin sites, two have particularly good faunal preservation and abundant faunal remains (David, 1994; Enloe, 1994; Enloe & Audouze 1997). Level IV-20 of Pincevent (Leroi-Gourhan & Brézillon, 1972) and several occupations of Verberie (Audouze & Enloe, 1991, 1994, 1997) exhibit heavy exploitation of reindeer, with numbers of identified specimens at over 95 % at each site. Minimum numbers of individuals for reindeer at Pincevent and Verberie are 76 and 97, respectively. Comparisons to other classes of data, lithic reduction for example, suggest that reindeer was the focus of activities at these sites. We can observe redundant patterning in seasonality and carcass processing of reindeer at these sites.

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## REINDEER

### Acquisition

The tactics of prey acquisition are perhaps more often presumed than demonstrated. Very interesting research by Bratlund (1996) found superior and posterior impacts on carcasses by weaponry, which she interpreted as evidence for spearing swimming animals from the shore at Stellmoor. While we lack direct evidence of killing methods, we can suggest similar methods of ambush or killing in the water. The sites are placed immediately adjacent to major rivers, most likely in close proximity to fording places. Migrating reindeer move quite quickly; it is probably only when crossing water that they are slowed down sufficiently for easy killing. There are several sagaie bone points at Verberie, and of particular interest is the one found at Pincevent with backed bladelets embedded along each side. Backed bladelets comprise about 50 % of the typologically retouched tools for these levels of each site, emphasizing the importance of hunting weaponry at Pincevent and Verberie (Enloe, 2000b).

### Seasonality

Given the predominance of a single species, the question becomes “How was a given species being exploited?” Details of the strategies of acquisition, processing and consumption will help us best understand the role of that species in short-

synchronized and quite useful for seasonality determinations. A number of juvenile mandibles from Pincevent and Verberie correspond to age cohorts of the first and second year (Fig. 1 & 2).

The fawns of the year have high, sharply pointed cusps on the deciduous tooth crowns, and permanent first molars only beginning to erupt. The yearlings have well-worn deciduous teeth, first molars in full occlusion and erupting second molars. Crown height measurements on mandibular  $D_4$ 's from Pincevent show very marked peaks at 10 and 5mm, with a significant void between the peaks (Fig. 3, from David & Enloe, 1992; Enloe & David, 1997). Those from Verberie show a similar pattern (Enloe, 1997; Enloe & David, 1997). The peaks at both sites indicate 4 month old and 16 month old cohorts, narrowing the seasonality determination to the fall migration, roughly the equivalent of early October. This is the ideal time for hunting reindeer, particularly if the strategic goal is the acquisition of considerable quantities of meat for storage. The prey have had the best nutrition of the year and are at their maximum body weight and fat content. The male bands and female and calf bands, having dispersed for feeding during the summer, are aggregated for the rut and beginning of the migration. Their social wariness is reduced, as they accustom themselves to the larger herd, and they are more easily approached. After this point, the males lose significant weight and most of their accumulated fat in the exertions of competition and reproductive activities; the largest food packages for hunters lose much of their

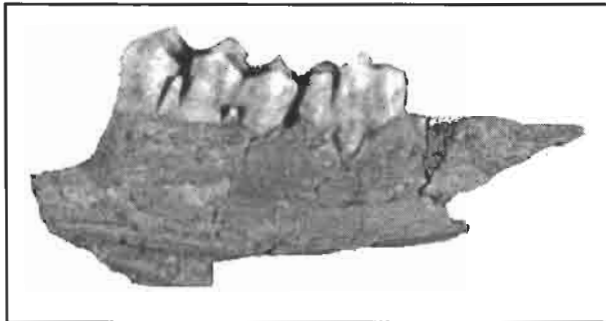


Figure 1: First year deciduous dentition.

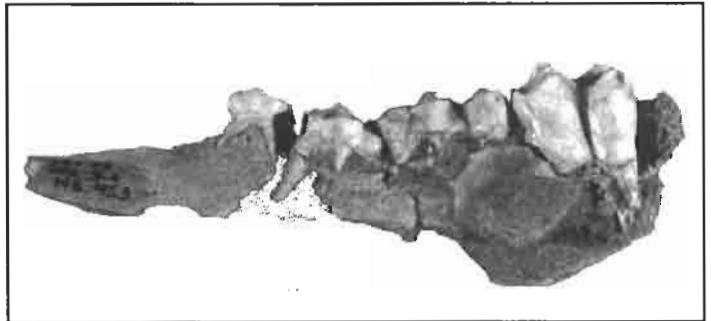


Figure 2: Second year deciduous dentition, erupting molar.

term and long-term adaptations to various regions occupied by Magdalenians. These details can also inform us about variations in the roles of sites within a local or regional adaptation. These questions are particularly important when it concerns exploitation of reindeer. Due to its potential for long range migratory behavior and seasonally differential use distant regions, reindeer can be exploited in radically different manners, ranging from simple opportunistic encounter hunting, as with many other territorial species, to planned strategic interceptions of migrations, with specific intention for mass kills and storage (Enloe, 1998, 2000a). The most key variable is seasonality. Evidence for seasonality comes exclusively from the reindeer fauna. At Pincevent and Verberie, massacred antlers of males and females indicate late summer to fall kills. A much closer calculation of seasonality can be derived from examination of the juvenile dentition. Since 95 % of all reindeer are born within a two-week period, their growth and development are highly

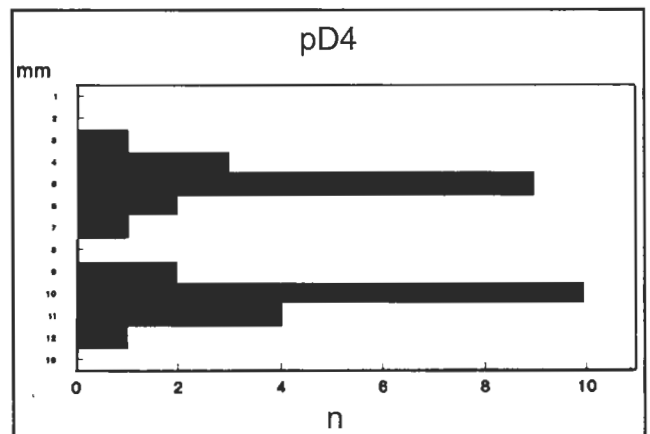


Figure 3: Forth deciduous premolar crown heights, with significant peaks at 5 and 10 mm, and complete lack of individuals at 8 mm, indicating very restricted seasonality of mortality events at Pincevent.

qualitative appeal. Females become the more attractive prey during the winter, but the reindeer bands become again dispersed in search of the scanty winter forage. Fall migration interception hunting thus can be seen as a strategic choice, the planned exploitation of single species to maximize the return of hunting effort.

**Selection**

As noted above in the discussion of seasonality, different ages and sexes among the prey population may offer different nutritional potentials in both quantity and quality. These factors were examined for both sites. Calves of the first year necessitate the presence of adult females at both sites, but what were the proportions of adult males to females? Sexual dimorphism among reindeer is not great, but certain osteometric observations help us to distinguish between adult males and females. At Pincevent, distal metacarpal breadth and depth were plotted against one another (fig. 4), yielding an easily divisible scatterplot (from David & Enloe, 1993: 42). This shows a fairly even representation of the smaller females and the larger males. However, observations of aggregated herds during the fall migration have shown that only 35 to 40 % of the adults are males. Even proportions in the mortality profiles suggest selection for males in the prey.

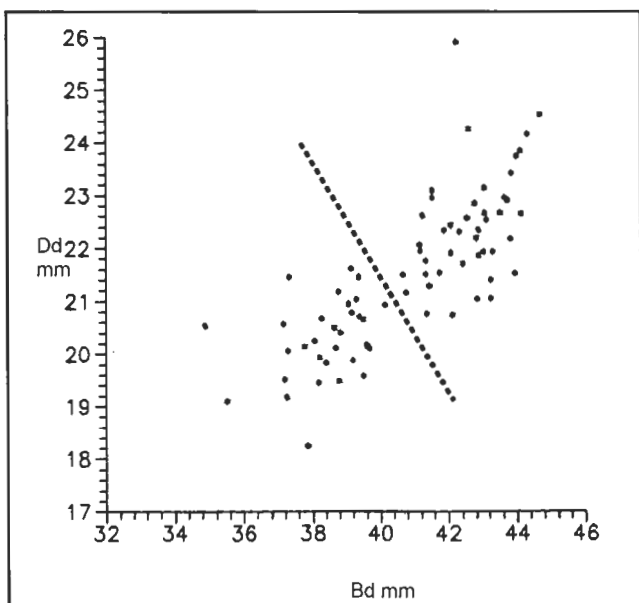


Figure 4: Sexual dimorphism of distal metacarpals, distal depth/distal breadth at Pincevent.

Age information for epiphyseal fusion of long bones is poorly understood and ambiguous in scattered carcass fragments. The dentition is most useful for calculating age and mortality profiles. At Pincevent (David & Enloe, 1993, p. 38), age classes were calculated from wear stages in comparison to modern control samples. They can be compared to a living population structure (Skoog, 1968) from the Nelchina modern caribou herd (Fig. 5).

Although the younger age classes are perhaps under-represented due to preservational biases, it is more significant

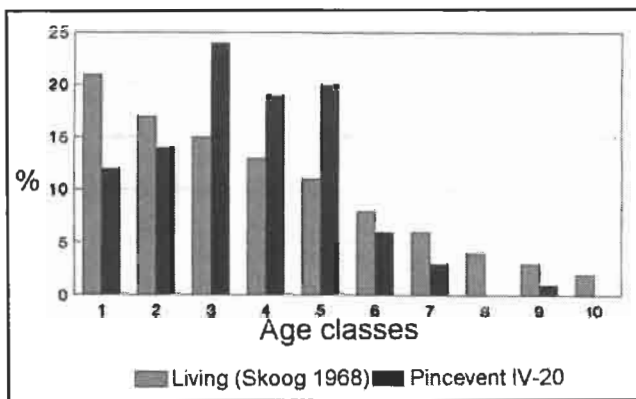


Figure 5: Mortality profile of Pincevent IV-20 (dark bars) compared to modern living profile (light bars). Note over-representation of prime-age classes (from David & Enloe 1993).

that age classes 3, 4 and 5 appear to be over-represented, corresponding to Stiner's 1991 classic prime-age mortality profile, suggesting highly selective targeting within the prey population. At Verberie, age classes were calculated by means of crown height measurements (Enloe, 1997), using Pike-Tay *et al.*'s (1993, 2000) adjusted quadratic equations from a large, known-age population. The pattern (Fig. 6) again indicates over-representation and selection, but it appears to be for a slightly younger target, with the 3 to 5 year olds under-represented. This may be a response to diminishing quality and weight among the dominant males, and a selection for pre-reproductive individuals of almost or fully adult stature, particularly for the young males.

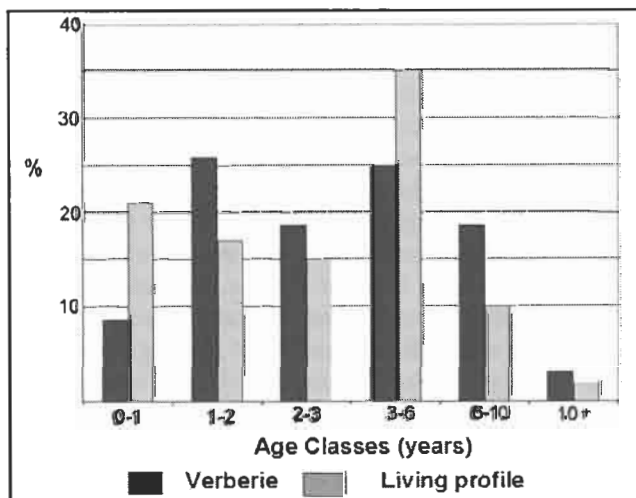


Figure 6: Mortality profile of Verberie (dark bars) compared to modern living profile (light bars). Note over-representation of younger than prime-age classes and under-representation of prime-age class.

**Processing**

Carcasses are relatively complete, except for an almost complete lack of vertebrae at Pincevent. For prey of this body size, vertebrae are frequently abandoned at the location of the kill or initial butchering. The meat can be stripped off the exterior; there is no medullary cavity for easily extractable marrow. At Pincevent, this probably indicates a transported

assemblage. There is little evidence for primary butchering. Density mediated attrition seems an unlikely explanation for differential skeletal representation, as numerous thin and fragile bones, such as hyoids and scapula blades, were preserved. Cut marks indicate disarticulation and meat filleting in roughly equal proportions (Enloe, 1991). Vertebral columns are quite common at Verberie, suggesting initial stages of butchering at this site. Root etching of the bone surfaces made identification of cutmarks problematic, so that the proportions of effort in initial butchering, processing for storage and distribution for consumption remain unknown.

Ethnoarchaeological observations have given us substantial information about butchering, particularly for reindeer. Binford's studies of the Nunamiut have yielded informative signature patterns about the content and spatial configuration of the residues of butchering activities. Initial butchering frequently results in an empty space where the carcass was processed on its skin, surrounded by immediately discarded low nutritional utility carcass parts. These butchering circles were identified at Anavik by Binford, and recognized by Francoise Audouze in the distribution maps of the uppermost occupation level at Verberie, with low utility parts such as phalanges and particularly vertebral columns around relatively empty spaces at some distance from the hearths. These kinds of butchering areas have been noted on other occupation levels at Verberie, often with unretouched blades left in the empty center area, upon which Larry Keely has found meat polish. I consider these fairly strong evidence for the identification of initial butchering at Verberie, suggesting its role as a hunting camp.

There were essentially no whole bones at either Pincevent or Verberie. All of the long bones with significant medullary cavities were systematically broken for marrow extraction. Even the first and second phalanges were cracked open to remove the single cubic centimeter of marrow in each. The spatial distribution of metapodial fragments was concentrated in certain areas to suggest mass processing of the marrow bones from multiple individual carcasses at one time, a fact consistent with mass kills for storage. We have no direct evidence for storage, no meat racks or other storage features. The presence of significant numbers of filleting cutmarks at Pincevent may allow us to infer processing of carcasses for storage. The fact that the major meat-bearing long bones have been processed for marrow extraction suggests that the meat had been already removed at both Pincevent and Verberie. The under-representation of ribs, having been snapped off from their heads along the vertebral column, may also be an indication of storage. Ribs have a very high surface to volume ratio, and are easily processed for storage with little additional labor input, and are quite favored for storage among modern reindeer hunters.

### Consumption

The final stages of processing involve further disarticulation of the transported carcasses for distribution to consumers and for preparation for cooking and eating. Food sharing patterns indicate close economic, social and, probably, kinship ties

among these Magdalenians, but we can see further evidence for variation between Pincevent and Verberie. The spatial distribution of refitted elements of individual reindeer carcasses was examined for information about distribution and consumption. At Pincevent, paired and articulated distal humerus and proximal radiocubitus elements often indicate that the left and right forelimbs of a single individual were shared between domestic households, such as this individual shared between hearths V105 and T112 (Fig. 7).

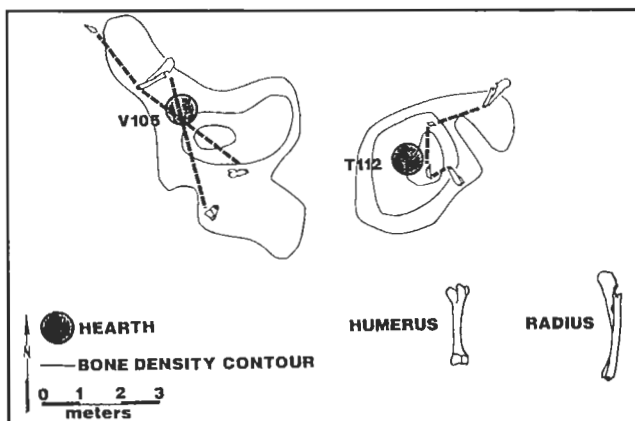


Figure 7: Distribution of refitted upper fore-limb elements from a single reindeer individual at Section 36 of Pincevent IV-20. The left limb is associated with hearth T112, while the right limb is associated with hearth V105.

When we examine this pattern of meat distribution at the level of the large excavated surface with numerous indicators of contemporaneous occupation, we can see long-distance refits of up to 63 meters (Fig. 8), indicating a high degree of economic and social integration among the inhabitants of the site. The greatest amount of interaction and food sharing occurred between the closest neighbors, a pattern that frequently indicates close kinship among modern hunter/gatherers.

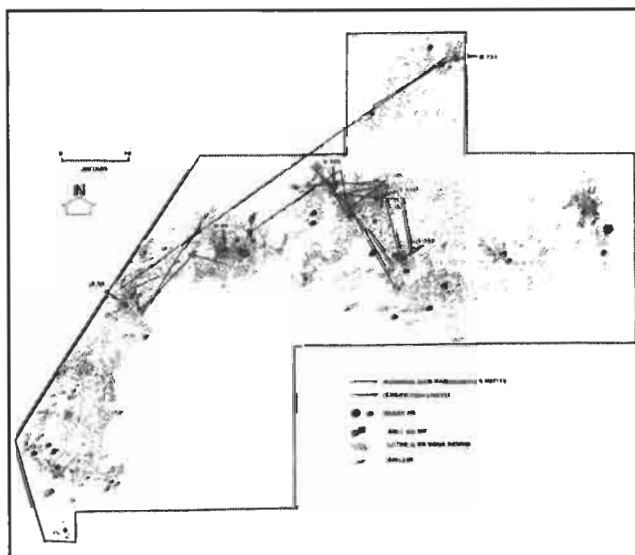


Figure 8: Distribution of refits of meat-bearing upper fore-limb elements across the occupation surface of level IV-20 at Pincevent. Note long-distance interactions between most hearth-centered households.

The paired distal metacarpals and metatarsals, which have no meat but are rich marrow sources, yielded another pattern, however. Paired elements from the same individual carcass were almost always associated with the same hearth, rather than shared domestic units, as we can see in figure 9 at hearths V105 and T112.

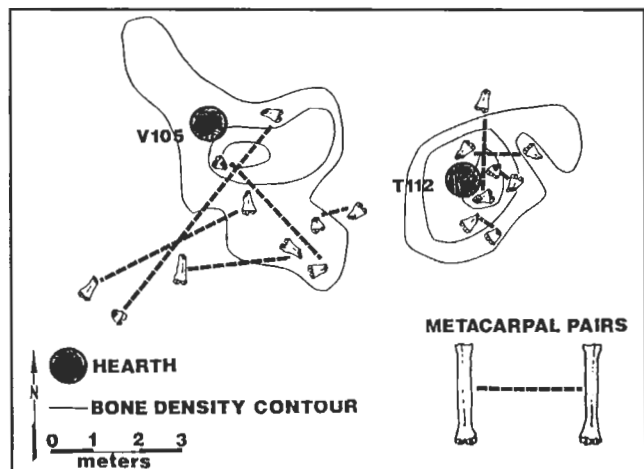


Figure 9: Distribution of refitted lower fore-limb elements from a several reindeer individuals at Section 36 of Pincevent IV-20. Pairs of left and right distal metacarpals from some individuals are associated with hearth T112, while other pairs are associated with hearth V105. Marrow-bearing metapodials do not appear to have been shared between hearths.

When we examine this distribution at the campsite level, we can see that only three of the domestic hearths that participated in long-distance meat sharing are locations of concentration of the marrow-rich metapodials (Fig. 10). These may be interpreted as the locations of the hunters' households, who are distributing meat but not marrow among their kin and neighbors. This marrow consumption pattern is frequent among hunters from tropical to arctic environments, often occurring at kill sites from which meat is transported to other consumers.

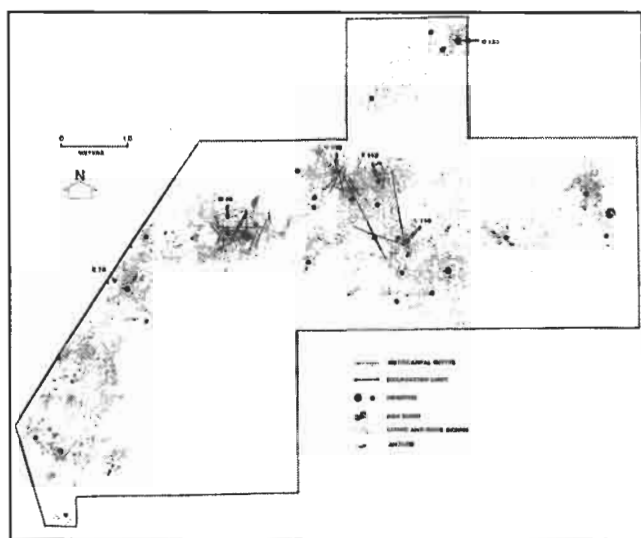


Figure 10: Distribution of refits of marrow-bearing lower fore-limb elements across the occupation surface of level IV-20 at Pincevent. Note the virtual lack of long-distance interactions between households.

For the uppermost occupation level at Verberie, for which the largest surface area has been excavated and the faunal assemblage studied, meat-bearing humerus and radiocubitus elements from the same individual carcass were most often found in the major trash dump between the two principal hearths (Fig. 11). The hearths do not appear to be equivalent to those representing domestic households at Pincevent, but appear to be functionally differentiated, D1 on the left having a food preparation aspect and M20 on the right having a lithic technological aspect. The distribution of meat-bearing elements suggests, instead of distribution to a number of consuming households, but rather some sort of corporate processing and communal consumption, as might be expected among members of a male task group, temporarily living and eating together, while preparing carcasses for transport to another consumption location more like that at Pincevent.

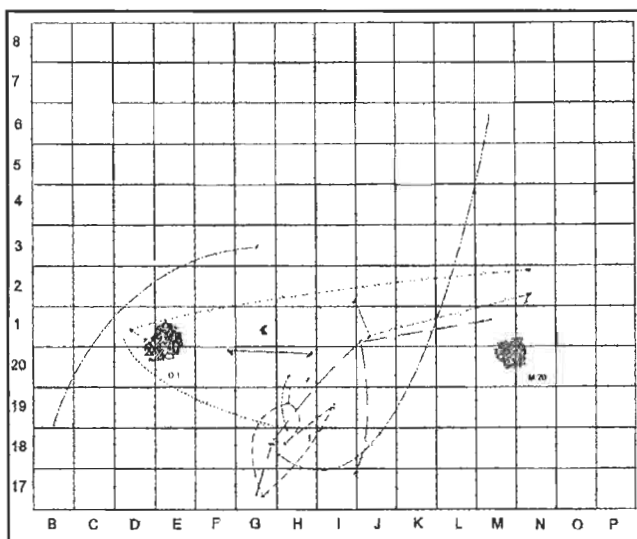


Figure 11: Refits between upper fore-limb elements of several individuals on level II-1 at Verberie. Most reindeer individuals appear to be associated primarily with a common dump area between hearths D1 on the left and M20 on the right. This is in contrast to the sharing of individual carcasses between household hearths on level IV-20 at Pincevent.

### Other species

While reindeer is very clearly dominant, and was the reason for the occupation of these sites, other species are present. The integration of exploitation of other species with that of reindeer may help us understand the convergence of patterns of land use in the exploitation of faunal resources and of lithic technological resources. At Pincevent, other species include horse, mammoth and wolf; the most frequent is hare. At Verberie, there appears to be a slightly wider diversity of species, including birds, fox, mammoth and rodents, most importantly ground squirrel. This species include at least 14 individuals. Several of the vertebrae bear obvious cut marks (Fig. 12), indicating that this species had been butchered and eaten by humans.

The second most common large mammal, after reindeer, is horse. It is present in all occupation surfaces, consistently

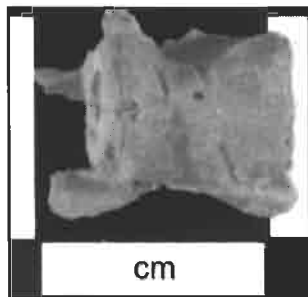


Figure 12: Cut marks on vertebra of *Spermophilus*, indicating butchering and probable consumption of ground squirrel at the reindeer hunting camp of Verberie.

but in small quantities when compared to the reindeer. Boyle (1993, 1994, 1997) emphasizes the importance of horses in late Magdalenian sites in the Périgord, noting a bulk utilization curve for this large-bodied species compared to a gourmet curve for the smaller reindeer. She argues that the abundance in the number of reindeer results in relatively little of each carcass being processed, while fewer individuals of horse were processed more intensively during another season (Burke 1993). This is not the case for the Paris basin sites. Differences in skeletal element representation would indicate the inverse. The reindeer were heavily exploited; all of the bones were smashed for marrow, including the first and second phalanges. These carcasses were taken for their bulk, for meat and for marrow. The exhaustive exploitation of carcasses is not inconsistent with mass kills. That may depend on the absolute quantity of animals killed in one's definition of mass. This depends on the weaponry technology, obviously, but also upon geographical facets of the environment. Because of the lack of topographic constraints, such as the Brooks Mountain Range through which Anaktuvik Pass channels the herds in large quantities, the open terrain of northern France may have meant smaller bands crossing the rivers at numerous points. This would be predictable in time and space, but the absolute number of prey may have been reduced. There may not have been even enough to last the entire winter, but the strategic stockpiling of food resources depended on exploitation of as much as possible of all prey individuals. Boyle's observation about non-exhaustive processing and exploitation of each reindeer carcass is consistent with fat-depleted winter kills (Speth 1983; see Enloe, 1993 for a discussion of early Upper paleolithic reindeer hunting) rather than just being wasteful in the face of abundance.

How do we understand the presence and exploitation of these other faunal species? What can understanding that tell us about how the reindeer was used? What was its strategic importance to late Magdalenians in the Paris Basin? First, the sites with well-preserved fauna have very limited and redundant seasonality. This suggests that the resources exploited at those sites were of critical importance to their occupants. Other game, other resources, could have been procured and exploited in spring and summer.

What we know about ethology of reindeer (summarized in Enloe & David, 1997) suggests that small bands would be dispersed across the landscape in summer, unpredictable in

location and numbers. Horse herds would have been similarly dispersed. An adaptation to that sort of resource availability structure would necessitate dispersal of hunters to increase the encounter rate of any and all species. Return rates per encounter would have been relatively small, just enough for immediate consumption and perhaps a small amount of storage to tide them over until the next encounter. If horse were acquired regularly enough, the amount that could be eaten and carried would be greater, perhaps making it the resource of choice in summer. The very fragmentary horse remains suggest introduction of a limited amount of food brought in from other sites at the beginning of the occupation. This might have been supplemented by *in situ* acquisition of small game, hare and ground squirrel, during the period they were waiting for the reindeer migration to arrive.

An important contrast with similarly dated sites in the Périgord is that of seasonality. Large sites in the Périgord exhibit evidence for longer, more intense occupations throughout the year. Boyle (1994, 1997) reports intensive exploitation of each horse carcasses during summer in Magdalenian sites in the Périgord, while reindeer carcasses were only partially processed from winter kills. The sites in the Paris Basin that have seasonality indicators appear to have been occupied only for relatively short periods in the fall.

Differences in the quantity and quality of marrow between equid and bovid or cervid species might have very large implications for seasonal exploitation of these various species in Pleistocene Europe. Equids contain quantities of marrow relatively smaller than artiodactyls in general (Outrand & Rowly-Conwy, 1988). Although the horse weighs approximately twice as much as the caribou, the deer provides over 13 times as much marrow as the equid (Blumenshine & Madrigal, 1993; West, 1995, 1997; Fig. 13).

In those terminal Magdalenian occupations of level IV-0 at Pincevent (Julien, 1998) and Grand Canton (Julien & Rieu 1999) and Tureau des Gardes (Bémilli, 1998; Lang, Bémilli & Caspar 1998) at Marolles, the presence of horse is greatly augmented, equaling or exceeding the number of reindeer individuals, and certainly representing greater quantities of meat. While this may reflect changes in climate and concomitant availability of species, it also represents a strategic change in the way species were used. At Marolles, the production of transformation tools (burins, bees, perçoirs and grattoirs) dominates the lithic assemblage, while that of backed bladelets is limited and opportunistic (Julien & Bémilli, 1999: 3). Notably present in level IV-0 (and in stark contrast to level IV-20) at Pincevent and also present in both sites at Marolles are large quantities of fire-cracked rock. The extreme fragmentation and total oxidation of these rocks at Pincevent IV-0 suggest high temperatures for long periods of time (March, 1998: 9). These may imply a different technique of processing carcasses when the species balance shifted from reindeer to horse. Marrow, still very important as a calorie source, could not be extracted by the simple mechanical means, as had been documented by Binford (1978) for Nunamiut processing of caribou. Horse marrow contains higher proportions of polyunsaturated acid, which make the marrow more liquid (Outram & Rowly-Conwy,



Figure 13: Comparison of medullary cavity of horse (left) and reindeer (right) metacarpals. The marrow content of the larger horse metacarpal is not only smaller than that of the reindeer metacarpal, but it is encased in both thicker cortical bone along the diaphysis and more spongy trabecular bone at the epiphyses, rendering it more difficult to extract.

1988). The osteological architecture of equid long bones differs from that of cervids (Blumenschine & Madrigal, 1993). Smaller medullary cavities and more trabecular spongy bone in the diaphyses surrounded by thinner cortical bones might necessitate another technical procedure for the extraction of fat from marrow and bone grease. Stone boiling (Lupo & Schmidt, 1997) could have been used to obtain the fatty material from horse bones, resulting in a much greater concentration of stones adjacent to hearths in Pincevent IV-0 and Grand Canton and Tureau des Gardes. Rather than concentrated seasonal hunts, dispersed and sequential hunts, each followed by complete processing of each carcass, are suggested for horse. This may also be true for reindeer as well; Bridault's (1996) determination of seasonality of mid March to mid May for reindeer at Tureau des Gardes would be consistent with a different pattern of exploitation of that species than at Pincevent IV-20 or Verberie.

Seasonal differences in the quality and importance of marrow may have been a key factor in the decisions made for species exploitation in this environment. Arguably poorer in resources than similarly dated sites in the Périgord or Pyrenees regions, occupants of those in the Paris Basin were forced to consider the role of marrow consumption for survival through the winter. Horses, even if available in considerable quantity or package size, did not offer the amount of calories necessary for metabolic needs, particularly the ability to efficiently digest meat. It is doubtful that much in the way of other resources would have been available in the northern frontier of Magdalenian settlement during the

winter. The very fact that reindeer were taken during their migration implies that they, too, were on their way out of the region for the coming winter. The Magdalenians of the Paris basin could not switch to other species, unlike their Périgord region cousins, i.e., reindeer coming south into their winter range. In the Paris Basin they were forced to rely strategically on storage from the fall migration kills for much of their winter food. The difference in the nutritional quantity of fat rich marrow was more important for surviving the winter than was the potential for larger packages of meat from bigger horses.

The strategic importance of reindeer may also be largely due to its predictable aggregation at the time of the year when meat and marrow are in their best nutritional condition. The predictability allowed for a mobilization of labor force for killing and processing sufficient numbers of carcasses to provide a stable basis for the Magdalenians to **count** on the reindeer for winter survival. In order to be in position at the correct time of the year to take advantage of that critical resource, they would need to be tooled-up and provisioned to wait for the right moment. They could not leave the strategic point on the landscape. I suggest that relatively small portions of summer killed horse were brought into the site the same way that exotic flint was. Minor hunting of very small game, the ground squirrel and hare, could take place without making expeditions away from the migration interception point, and could supplement the imported food. Thus these species, horse and small game, had important supporting roles in the tactics of acquiring the most critical species, reindeer. The use of the minor species made possible the strategic role of reindeer acquisition and processing in winter survival.

## CONCLUSIONS

Reindeer hunting is clearly the focus of subsistence activities for many of the Magdalenian sites in the Paris Basin for which we have substantial faunal preservation. Sites such as Pincevent and Verberie exhibit redundant patterning in seasonality and carcass processing, indicating that fall migration interception was a strategic choice for the acquisition of significant quantities of food for the entire year. A large portion of their economic systems was based on the planned exploitation of this single species. Patterns of exploitation of very small amounts of other species are consistent with the necessary predominance of reindeer. Nonetheless, environmental constraints probably precluded exclusive dependence on reindeer throughout the year. Food sharing patterns between occupants of Magdalenian campsites indicate close economic, social and, probably, kinship ties among these Magdalenians. On the whole, reindeer exploitation patterns in the Paris Basin appear to exhibit significant variation from those of other regions, particularly the Périgord, particularly in the seasonality of reindeer hunting and the modes of exploitation of their carcasses. There also appears to have been evolution in subsistence activities reflecting climatic change at the end of the Pleistocene. A shift from the focus on reindeer and the

strategic fall migration hunts and a shift to year-round exploitation of horse and reindeer probably indicates adoption of a new form of subsistence adaptation by local groups during the terminal Magdalenian.

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