

# SEASONALITY AND AGE STRUCTURE IN REMAINS OF *Rangifer tarandus*: MAGDALENIAN HUNTING STRATEGY AT VERBERIE

James G. ENLOE\*

## Summary

Faunal remains at the late Upper Paleolithic campsite at Verberie (Oise) are composed almost exclusively of *Rangifer tarandus*. Dental remains from this species are inspected for indications of seasonality of death and mortality age profiles. Samples from several successive occupation levels are compared. Seasonality is consistently fall, during the migration. Selection for young adults and for males is indicated. From these data it appears that the hunting strategies of the Magdalenian occupants of the site may have focused on procurement for storage.

## Résumé

Saisonnalité et structure des âges des restes de *Rangifer tarandus* : stratégie de chasse magdalénienne à Verberie.

Les restes de la faune du site du Paléolithique supérieur de Verberie (Oise) sont presque exclusivement composés de renne (*Rangifer tarandus*). Les séries dentaires de cette espèce sont étudiées afin de trouver des indices de saisonnalité et des courbes de mortalité. Des échantillons de plusieurs niveaux d'occupation successifs sont comparés. L'occupation a toujours lieu à l'automne, au moment de la migration. Une sélection pour les adultes jeunes et pour les mâles apparaît. D'après ces données, il semble que les stratégies de chasse des habitants magdaléniens du site soient orientées vers l'approvisionnement pour le stockage.

## Zusammenfassung

Saisonalität und Altersstruktur der Überreste von *Rangifer tarandus*: Magdalénienzeitliche Jagdstrategie in Verberie.

Die Knochenreste der jungpaläolithischen Fundstelle von Verberie (Oise) stammen fast ausschließlich vom Rentier (*Rangifer tarandus*). Die Zähne dieser Art werden auf die Jahreszeit des Todes und die Altersstruktur hin untersucht. Es werden Proben aus verschiedenen Besiedlungsniveaus miteinander verglichen. Die Besiedlung der Fundstelle erfolgte immer im Herbst, während der Wanderung der Tiere. Es kann eine Selektion zugunsten der jungadulten und männlichen Tiere nachgewiesen werden. Diese Beobachtungen scheinen auf eine Jagdstrategie hinzuweisen, die auf das Anlegen von Vorräten ausgerichtet war.

## Key Words

Paleolithic, Seasonality, Hunting, Magdalenian.

## Mots clés

Paléolithique, Saisonnalité, Chasse, Magdalénien.

## Schlüsselworte

Paläolithikum, Saisonalität, Jagd, Magdalénien.

## Introduction

*Rangifer tarandus* has been argued (Mellars, 1989) to be the basis of specialized hunting strategies throughout the Upper Paleolithic. It has been demonstrated (Enloe, 1993) that this species was also taken as territorial game as a function of availability during severe climatic regimes during the early Upper Paleolithic. Nonetheless, the occupation of the Paris Basin at the end of the Pleistocene was a pioneering settlement into formerly unoccupied territory. Mellars (1994:

76) has argued that an adaptive response to rapidly changing environmental conditions at the end of the Pleistocene was to retreat northward from the classic Paleolithic regions such as the Périgord, to colonize newly emerging environments in northern Europe, such as the Paris Basin, in order to maintain their grip on open environments and continue to exploit the same animal species.

The mere presence or even predominance of *Rangifer* in the assemblage is insufficient to characterize the

\* Dept. of Anthropology, The University of Iowa, 114 Macbride Hall, Iowa City, IA 52242-1322, U.S.A.

exploitative aspects of human subsistence patterns. We must ask more specific questions. What problems in adaptation were being solved by this expansion of territory? How were these animal species being exploited? *Rangifer* can be exploited in a variety of ways, not just as variation in hunting tactics, such as stalking, ambush, drives, etc., but also as fundamental variation in hunting strategies. The difference between tactics and strategies lies in understanding what fundamental subsistence need the resource fulfills in the environmental context. Are single or small numbers of prey being taken for immediate consumption, regardless of the species? Or, are certain species being targeted because they can help solve a problem posed by the environment? Because of its seasonally migratory behavior, *Rangifer tarandus* can provide a predictable large quantity of food, for which sufficient labor forces for hunting and processing can be organized at a predictable location and time. In short, food can be stored for the winter. *Rangifer* can also be hunted as any other species available at hand, with no overall strategic consideration, as was probably the case at the Abri Pataud (Spiess, 1979) or le Flageolet (Enloe, 1993).

In order to assess the strategic considerations of *Rangifer* exploitation patterns, it is necessary to examine closely population parameters of the target species. In particular, the seasonality of hunts and the mortality profile of the targeted prey can give important information for understanding the overall strategy of Magdalenian hunters in northern Europe.

## Verberie

The late Magdalenian site of Verberie can give us some insight into this problem. It is characterized by several hearths with dense associated artifactual and faunal debris (Audouze *et al.*, 1981; Audouze, 1987; Audouze and Enloe, 1991). The well-preserved fauna at Verberie is dominated by reindeer (*Rangifer tarandus*), comprising over 98% of the assemblage (David, 1994; David and Enloe, 1992; Enloe, 1994).

Although Verberie has been excavated since 1976, it is only in recent years that we have discovered that in certain areas of the site remains from multiple levels of occupation have been preserved under the original occupation described by Audouze *et al.* (1981). These levels in the Pleistocene stratum II are identified as II<sub>1</sub>, the upper, most recent occupation, II<sub>2</sub>, the second, II<sub>21</sub>, the third, discerned after II<sub>2</sub> and II<sub>3</sub>, and II<sub>3</sub>, the fourth occupation. We know from test pits that there is at least one more level, II<sub>4</sub>, but we have not yet been able to excavate any of this beyond our tests. Obviously, more surface area has been excavated

for the upper occupation surfaces ca. 210 m<sup>2</sup> for II<sub>1</sub> and ca. 120 m<sup>2</sup> for II<sub>2</sub>, and correspondingly less for the lower ones, ca. 80 m<sup>2</sup> for II<sub>21</sub> and ca. 35 m<sup>2</sup> for II<sub>3</sub>.

These different occupation surfaces offer the opportunity to examine details of the hunting strategies of the Magdalenian occupants of the site. Multiple occupations allow us to examine repeated episodes of hunting, from which we may be able to discern possible strategies. Single incidents may be distorted, masked by periodic anomalies in prey herd structure, such as missing cohorts of young animals, due to late spring storm kill off of new calves. Was there a consistent demographic target in the reindeer prey? Could information on the prey population shed light on specific tactics of the hunt at Verberie and on general strategy of Magdalenian hunting in the Paris Basin?

All elements of the skeleton are present at Verberie, but there appears to be differential representation of skeletal elements, particularly when compared with Pincevent, the only other Magdalenian site in the region with well-preserved reindeer remains. Of particular interest are the numerous articulated segments of vertebral columns. Ethnoarchaeological evidence suggests that these elements are frequently abandoned at close proximity to the kill site, where initial butchering for transport might take place. Such elements are absent at Pincevent, suggesting that it was more a consumption location than one of primary acquisition. In contrast, Verberie appears to be a hunting campsite, more closely concerned with direct acquisition and initial processing of carcasses. As such, it may yield information about hunting strategies more directly, without having passed through the filter of transported assemblages.

This analysis is focused on the mandibular dental remains of the reindeer. Dental remains are the best preserved and best represented skeletal element present. It is also the most useful for determining age and seasonality, which are critical factors in understanding the exploitation of a highly seasonal food resource like reindeer.

## Minimum Number of Individuals

The Minimum Number of Individuals is derived from the frequency of 38 right P<sub>3</sub>'s from adults and 21 right D<sub>3</sub>'s from immature individuals. This minimal MNI totals 59. This figure can be refined by several procedures. First, deciduous dental series were separated from fully permanent series. This yielded 41 left permanent M<sub>1</sub>'s and 24 deciduous D<sub>4</sub>'s, increasing the total to 65. Second, the first year individuals were separated from the second year individuals in the deciduous dentition, based on wear on the deciduous teeth and eruption of the permanent molars. This

yielded 6 right  $D_4$ 's in the first year and 18 right  $D_4$ 's in the second year, which did not increase the total.

One goal of this investigation is the elucidation of actual number of individuals killed and processed at the site. Therefore Poplin's (1976) comparison method of calculating the minimum number of individuals was employed. The hemi-mandibles, dental series and individual teeth were examined for side and tooth identification. Teeth were placed into dental series when specimen fragments had matching breaks. Left and right mandible halves and teeth were matched according to size and similarity of cusp and wear patterns. These proved to be sufficiently individualized to determine that a given isolated tooth could not be derived from a particular individual, so that another individual could be recognized. This procedure was employed in the first year calves, the second year sub-adults and the adults with fully permanent dentition. Partial overlaps of teeth in dental series within each broad age class were used further to identify additional individuals. A total of 97 individuals, represented by from one to twelve teeth each, was achieved. This population was the basis for the study of age parameters. This includes 34 individuals for level  $II_1$ , 24 individuals for level  $II_2$ , 32 individuals for level  $II_{21}$ , and 7 individuals for level  $II_3$ .

### Seasonality

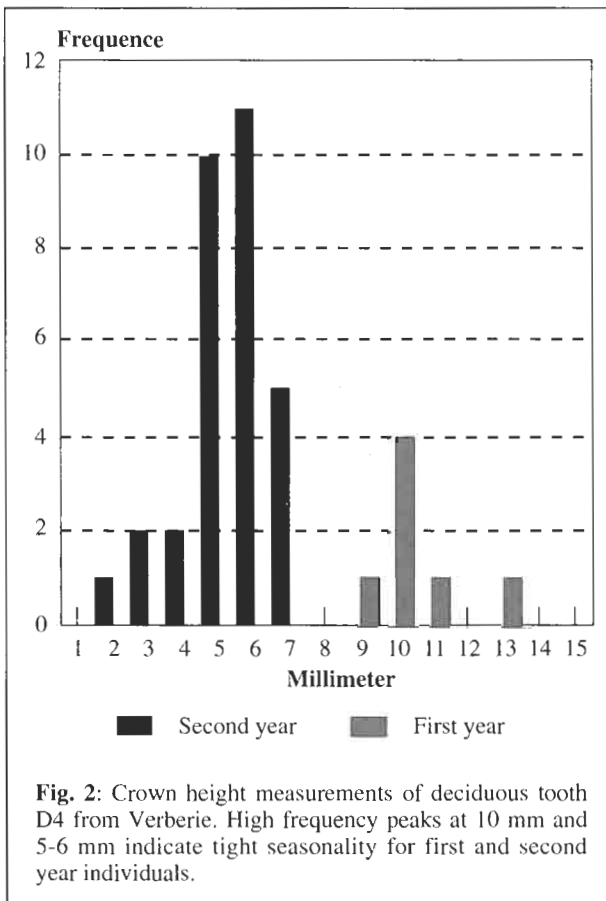
Seasonality is a crucial variable in the exploitation of *Rangifer*. Hunting during the winter or summer cannot yield the same predictable massive food resource for the strategic goal of potential winter storage as can hunting during the fall migration. Hunting during the spring migration yields prey in a depleted nutritional state, and is thus both qualitatively and quantitatively inappropriate for long term strategic goals. Hunting throughout the year may be responsive to different short or long term goals. Therefore, determination of seasonality is a crucial prerequisite for examining hunting strategy.

Seasonality can be determined by a number of indicators. Bryan Gordon's (1988: 86) analysis of cementum annuli of teeth from Verberie yielded equal increments from summer, fall and late winter. This type of analysis has been criticized due to loss of the outermost annuli during specimen preparation. Spiess (1979: 69) reported that only 10 of 171 specimens from Abri Pataud were successfully sectioned and readable. Contradictions between annuli counts and other age determinations at Pincevent suggest (Enloe, 1991: 134-135) that problems exist also for reading of the final annulus to determine seasonality. My analyses indicate different results from Gordon's findings at Verberie.

The best indicators of seasonality can be found in the eruption of permanent teeth and wear of the deciduous dentition. Since *Rangifer* exhibits highly synchronized births, tooth eruption age determinations can yield fairly precise determinations of age at death. Miller (1974) observed the timing of permanent dentition eruption in several herds in North America and Asia. The first permanent molar erupts between 3 and 5 months, while the deciduous teeth have high, sharp cusps. The second permanent molar erupts between 10 and 15 months, while the cusps of the deciduous teeth have become worn and flattened. The majority are in occlusion by 13 months and all are in occlusion after 15 months. The third permanent molar can erupt between 15 and 29 months, and is not useful for seasonality determinations. In the Verberie fauna, there are 8 individuals which exhibit very lightly worn deciduous teeth and erupting first molars (e.g. fig. 1 top), corresponding to calves of their first year. There is another group of 26 individuals with well worn deciduous teeth, slightly worn first permanent molars, second molars just coming into occlusion, and



**Fig. 1:** Mandibular dental series of *Rangifer tarandus* from Verberie. Top: High crowned  $D_3$  and  $D_4$  of first year individual. Bottom: Very worn  $D_4$ , slightly worn  $M_1$ , and  $M_2$  just coming into occlusion, second year individual.



**Fig. 2:** Crown height measurements of deciduous tooth D4 from Verberie. High frequency peaks at 10 mm and 5-6 mm indicate tight seasonality for first and second year individuals.

occasional buds or erupting third molars (e.g. fig. 1 bottom); these correspond to individuals in the second year. The similarity in eruption and wear within each of these groups suggests limited seasonality. Spiess (1979: 78) noted that "Deciduous molar wear patterns will only appear discrete in sites of limited season hunting."

We can go to measurement of the wear of the deciduous teeth for a more precise determination of seasonality. Crown heights were measured for D<sub>4</sub>, the most frequently occurring tooth. The frequency distribution of these measurements are plotted in figure 2. It can be seen that there are two very strong peaks in the frequency of wear, at 10 mm and at 5-6 mm. These peaks correspond to the first and second year cohorts and indicate that each cohort was killed during a very restricted time period. In conjunction with the eruption of the first and second permanent molars, these data indicate synchronized mortality at 3 to 5 months and at 15 to 17 months for the second year, death between mid-August and mid-October, corresponding to the fall migration.

Do the data from the different levels indicate consistent seasonality for each occupation? Each level includes

from 6 to 11 individuals from first and second year cohorts, which gives sufficient information to confirm a consistent pattern for each occupation. This begins to suggest a strategic goal for *Rangifer* hunting at Verberie.

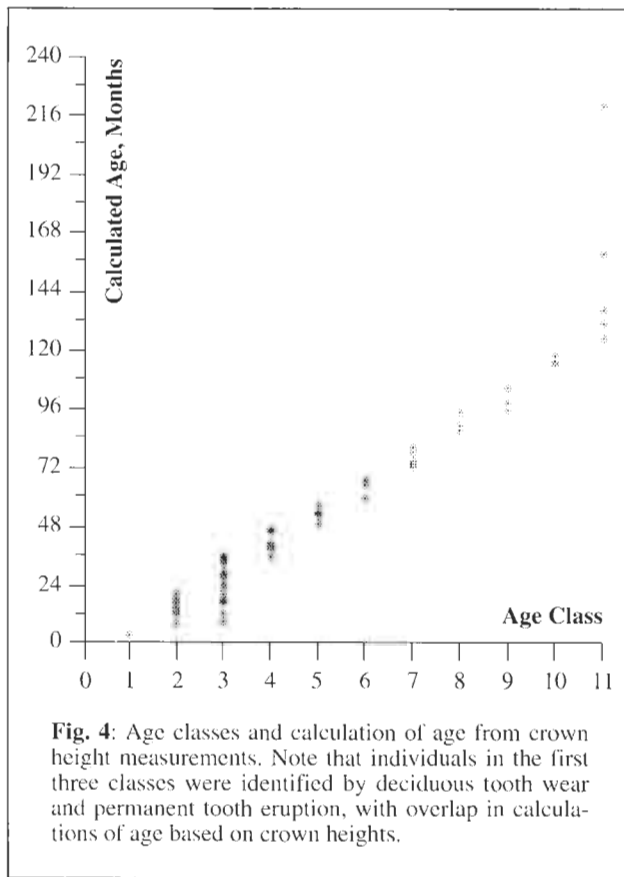
### Age structure

Age structure or mortality profiles derived from dentition have been frequently used to interpret hunting patterns of early humans and other carnivores (Kurtén, 1953; Voorhies, 1969; Klein, 1982; Stiner, 1990). The mandibular material from Verberie demonstrates the inapplicability of simplistic wear stages (cf. Bouchud, 1966) to determine the ages of individual mandibles. There are great differences among individuals in the motor habits of chewing which have resulted in greatly different patterns of wear on mandibular teeth. On some individuals (fig. 3 top), once all of the permanent teeth have erupted and come into occlusion, the tooth row appears to wear fairly evenly. On others (fig. 3 bottom), however, the back teeth wear faster than the front teeth and wear out while the premolars are relatively unworn. On still other individuals, the premolars appear to wear faster than the molars.

Because tooth wear is not linear, occurring faster on the smaller surface area of high crowns than on the increased surface area of worn teeth, Klein *et al.* (1983) proposed the application of a quadratic equation to crown



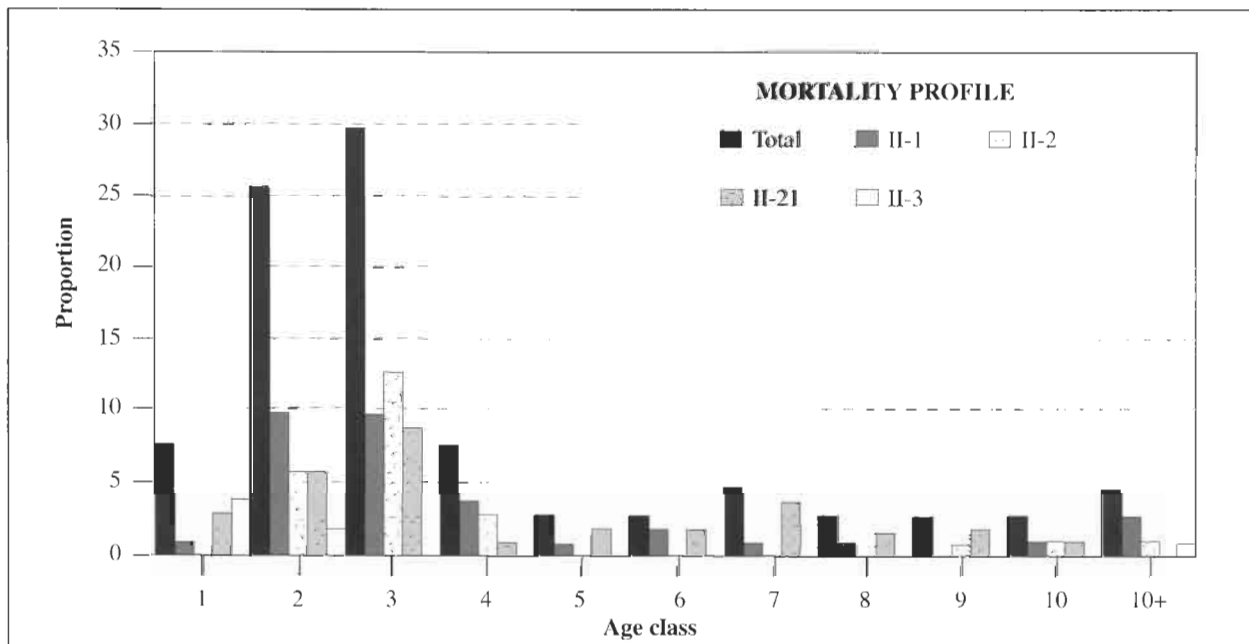
**Fig. 3:** Wear patterns on adult *Rangifer tarandus* from Verberie. Top: Even wear and similar crown heights on premolars and molars. Bottom: Radically different wear and crown heights, with high premolars and very worn molars.



height measurements of *Cervus elaphus* to determine age and mortality profiles for prey populations. Pike-Tay *et al.* (1993) tested the quadratic regressions of age on a large, known age sample of *Rangifer*, and then modified them to achieve a better fit to the curve of the known age population. Their equations for third and fourth premolars and for first, second and third molars were used to calculate age for each tooth specimen for which a measurement of crown height was possible in the Verberie dental material. Due to variations in wear on the teeth in a single mandible, all of the individual tooth calculations were averaged for each individual animal.

Pike-Tay *et al.* suggest that problems in extreme height variability in youngest age classes necessitate calculation of their age by other means, so deciduous wear and permanent eruption stages were used to place individuals in the first three age classes. Similarly, the very oldest age class calculations were based on such small samples that precise determination of months of age by their equation cannot be considered highly reliable. For the Verberie old mandibles, maximum age calculations indicated up to 125, 131, 136, 159, and even 219 months. The relationship between mean age calculations from the modified quadratic equation and the age classes assigned are shown in figure 4.

Figure 5 shows the frequency of individuals assigned to age classes of one year intervals, for the total assem-



**Fig. 5:** Frequency of individuals in age classes for total Verberie assemblage and for each occupation level. Age classes correspond to one year intervals.

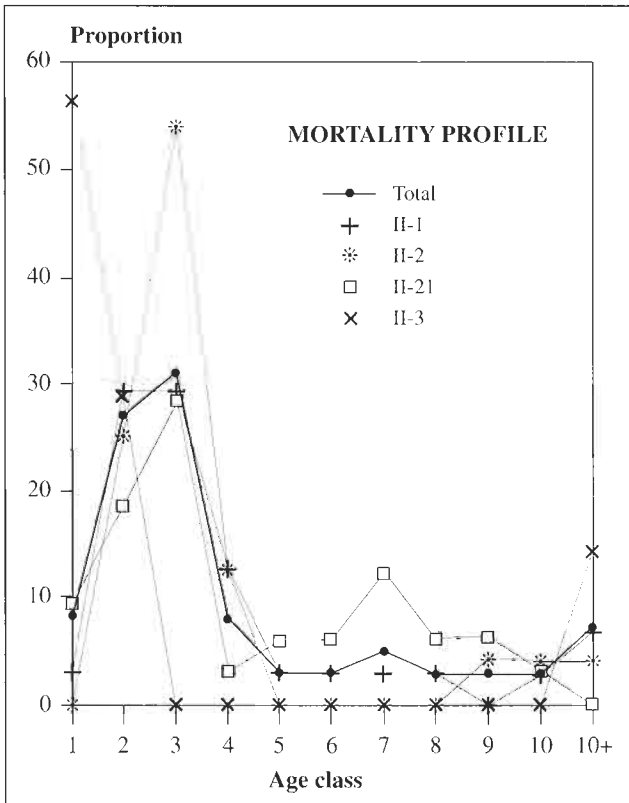
blage, and also for each occupation level. The highest bars for each age class represent the total assemblage. It can be seen that the largest frequencies are for the first four age classes, especially for the second and third year cohorts.

Because of the different numbers of individuals represented in each level, these frequencies were normalized to percentages in each age class, shown in Figure 6. With the exception of II<sub>3</sub>, which had the smallest excavation surface and lowest number of individuals and, thus, the greatest problem of sampling bias, all of the levels exhibit the same pattern, already noted for the total assemblage. Individuals of the second and third year cohort are very strongly represented, while older adult cohorts comprise much smaller proportions within each level. Does this constitute a specialized selection?

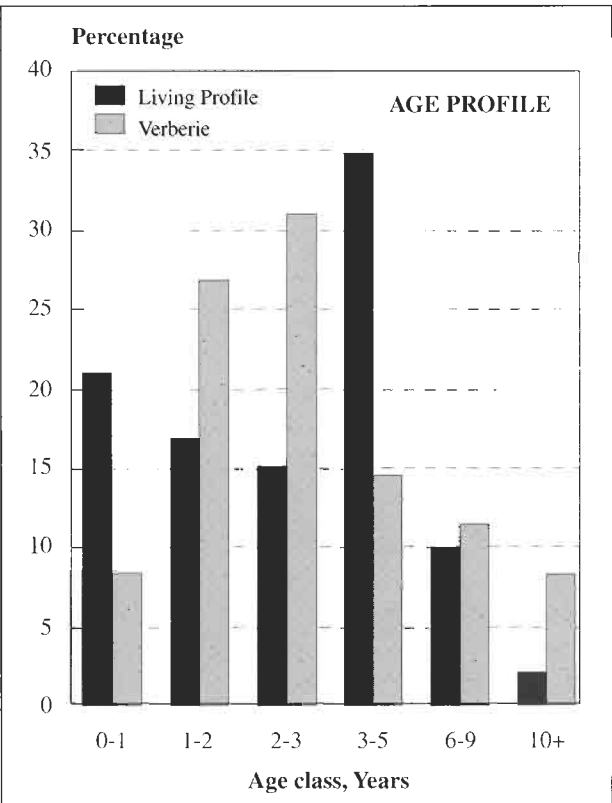
The age distribution can be compared to the proportions of age classes reported by Skoog (1968: 515) for the Nelchina herd during the fall migration (tab. 1 and fig. 7).

The differences in proportions of age groups are very significant, with a Chi-square value of 50.6151, which is significant for five degrees of freedom with a probability of less than 0.0001. Comparisons between the occupation levels contain too many zero cells to have statistical significance. The differences in the total population are most marked in the over-representation of the second and particularly the third classes, and the under-representation of the 3-6 year age class.

This corresponds to a certain degree to Stiner's (1990: 309) prime-dominated mortality pattern, which implies selectivity by hunters. While Stiner argues that the prime-dominated procurement focuses on the age group with the highest reproductive potential, the case at Verberie seems to be slightly nuanced from that pattern. The highest representation of second and third year animals may not be those with the highest reproductive potential. McEwan (1963) reported that reproductive success in females increases after the third



**Fig. 6:** Proportional mortality profile for occupation levels and total assemblage at Verberie. Note the consistent peak at age classes 2 and 3, indicating selection for young individuals.



**Fig. 7:** Comparison of age profile from living *Rangifer tarandus* population of the Nelchina herd (Skoog, 1968: 515) with mortality profile from Verberie. In the Verberie faunal assemblage, young individuals are over-represented and prime age, reproducing adults are under-represented.

**Table 1:** Comparison of age groups between Nelchina herd and Verberie assemblage.

Age Class	%	NELCHINA		%	VERBERIE		Total
		O	E		O	E	
0-1	21	210	199	8.2	8	19	218
1-2	17	170	179	26.8	26	17	196
2-3	15	150	164	30.9	30	16	180
3-6	35	350	332	14.4	14	32	364
6-10	10	100	101	11.3	11	10	111
10 +	2	20	26	8.2	8	2	28
Totals		1000			97		1097

$\chi^2 = 50.6151^{***}$ , significant for  $df = 5$ ,  $p < .0001$   
O = Observed; E = Expected

year, and does not decrease even with extreme age. Males may form harems with 3 to 15 females associated with a dominant male, effectively excluding many of the subdominant males from reproductive participation. Reproductive behavior is not consistent with nutritional criteria for prey choice. Males participating in the rut lose most of the summer's accumulation of fat and up to 20% of their body weight. Younger females are less likely to produce offspring. Thus, selection of the younger adults and larger subadults may not result in decreases in reproductive success of the prey population.

Stiner (1990: 317) noted that prime-dominated harvesting probably involves considerable selection by sex as well as by age, requiring a large measure of selective control. Since dental measurements of *Rangifer* are not reflective of sexual dimorphism, other data must be sought to address this point. Postcranial measurements from this assemblage indicate that ca. 60% of the population is composed of males. Summarizing biological reports, Kelsall (1968: 154) concludes that adult male to female ratios in breeding populations average 27 to 100. This suggests very heavy selection from within the potential prey population. This selectivity for young, non-reproducing males would be consistent with conscious conservation of a key resource, and it would also yield the highest quality meat, from which fat reserves would not be depleted.

## Conclusion

These data, when taken together, suggest a very specific tactics to acquire substantial quantities of meat. Exploitation of *Rangifer* at this site occurred consistently during the fall migration. There is no discernible variation in the sea-

son of hunt among the four occupation levels. Hunters obviously anticipated coming to a specific location at a specific time of the year in order to harvest a predictable resource. This amounts to a planned strategy, rather than a haphazard encounter.

A specific portion of the population was targeted to maximize both the quantity and quality of the food resource. Other species were being exploited by the Magdalenians of the Paris Basin. At Verberie, there is also evidence of horse and ground squirrel. While the latter was undoubtedly killed on the spot, the horse remains are so sparse and fragmentary that they probably represent food that was brought into the site before the hunt for the reindeer. While analyses of the rest of the faunal assemblage are continuing, the differential representation of skeletal elements seems to indicate that the proceeds of the hunt were taken elsewhere, quite possibly for storage and consumption through the winter. As such, this does constitute evidence of a strategy of planned hunts for storage, rather than random events of encounter hunting and immediate consumption. This suggests that Magdalenians may have been exploiting reindeer in a slightly different way than can be seen in the Périgord, supplying fewer people for longer periods of time. This may be seen as a means of adapting to a more northern and potentially harsher open environment during the rapidly changing environment at the close of the Pleistocene.

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