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WILD BOAR – AGE AT DEATH ESTIMATES: THE RELEVANCE OF NEW MODERN DATA FOR ARCHAEOLOGICAL SKELETAL MATERIAL.

2. SHAFT GROWTH IN LENGTH AND BREADTH. ARCHAEOLOGICAL APPLICATION.

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Abstract - The present day reference collection presented in Bridault et al. (this volume) is now investigated to test the possibilities of using growth of shaft lengths and breadths for determining the skeletal age of the wild boar. Until about 10 months, correlation are good with age for the 18 tested bone measurements. Only four of them (GL d radius and femur, SLC scapula and SD humerus) could be used for older ages, till 2 years. It has not been possible to model growth of every measurement because the collection still lacks animals younger than 6 months. Though preliminary, these results are then tested on the Mesolithic wild boar assemblage of Noyen-sur-Seine (Northern France), which does not include any tooth. Precise determination of age structure suggests very short boar hunting session(s) and collective hunting techniques targeting groups of young and females. This archaeological application confirms that using bone measurements is only possible for boar younger than 10-12 months, but also shows that this method produces much more precise and powerful results than epiphyseal fusion.

Résumé - Nouveau référentiel pour la détermination de l'âge squelettique chez le sanglier (*Sus scrofa*). 2. Croissance des diaphyses en longueur et en épaisseur. Application archéologique. La collection de référence actuelle présentée par Bridault *et al.* (ce volume) est ici utilisée pour tester une méthode de détermination de l'âge des sangliers fondée sur la croissance des longueurs et largeurs diaphysaires. Jusqu'à 10 mois environ, on observe une bonne corrélation avec l'âge pour les 18 mesures examinées. Quatre d'entre elles seulement (GL d radius et fémur, SLC scapula et KD humerus) pourraient être utilisées au delà, jusque vers 2 ans. Il n'est pas possible de proposer une modélisation mathématique de la croissance de chacune des mesures, la collection étant pour l'instant insuffisamment documentée pour les âges inférieures à 6 mois. Bien que préliminaires, ces résultats sont ensuite appliqués aux restes de sangliers du site mésolithique de Noyen-sur-Seine (Seine-et-Marne), qui ne comporte pas de dents. On accède à une détermination précise de la structure d'âge, qui suggère que la où les actions de chasse étaient collectives, se sont déroulées dans un temps très court et visaient des groupes de femelles suitées. Cette application archéologique confirme que la méthode de détermination des âges par la mensuration des os ne peut guère s'appliquer au delà de 10-12 mois, mais aussi qu'elle est beaucoup plus précise et performante que l'utilisation des âges d'épiphyseation.

Key-words: Wild boar, *Sus scrofa*, Ageing, Skeletal growth, Osteometry, Mesolithic.

Mots clés: Sanglier, *Sus scrofa*, Détermination de l'âge, Croissance squelettique, Ostéométrie, Mésolithique.

1. Introduction

In some cases, archaeological mammal assemblages lack teeth (*e.g.* Vigne, 1988:) or need accurate data for very young animals, before the earliest epiphyseal fusion events (*e.g.* for determining culling season). Concerning the England Mesolithic site at Star Carr, Legge & Rowley-Conwy (1988) demonstrated that growth in breadth of deer scapula collar were well correlated with age of young animals. It was again Legge *et al.* (1991) who successfully applied this technique to caprine bones from the Roman temple at Harlow (England). The aim of the present paper is to test the correlation between age versus breadths and lengths of some wild boar skeletal components, and the possibilities of applying them to archaeological collections. This research is based on the investigation of the 48 complete skeletons of present day wild boars collected in the Oise département (Paris Basin) and presented in Bridault *et al.* (this volume).

2. Investigation of the present day Oise reference collection

2.1. Method

Eighteen measurements have been registered with a 1/20^e mm caliper:

- maximal length (GL d) of both proximal and distal unfused shaft of humerus, radius, ulna, femur, tibia and calcaneus;
- maximal medio-lateral breadth (Bp d) of proximal unfused shaft of radius and tibia;
- minimal dorso-ventral diameter of the scapula collar (following von den Driesch, 1976: SCL);
- minimal breadth of the shaft of humerus, radius, femur and tibia (von den Driesch, 1976: SD);
- maximal height between the lateral edge of the acetabulum cavity and the sciatic crest of pelvis (D acet.);
- lateral and medial lengths and distal breadth of talus (von den Driesch, 1976: GLl, GLm and Bd);

- diagonal length of the sole of 3rd phalanges of 3rd and 4th fingers (von den Driesch, 1976: DLS).

Death ages of the 48 wild boar of the collection have been taken according to Bridault *et al.* (this volume).

Scatter diagrams with osteometric values and ages have been drawn for each of the 18 measurements. In order to model the relation between them, linear, logarithmic and 2, 3, 4 and 5 degree polynomial regressive adjustments have been compared, on the basis of the value of the correlation coefficient "r" (Microsoft Excel 97 package).

2.2. Results

Figures 1 and 2 give the scatter diagrams and the best regressive adjustment for the ten breadth and for the eight length measurements, respectively. Generally speaking, increase of length measurements with reference to age appears to be maximal between the 4-5th and the 10th months, though it slows down earlier for the talus lengths (7-8th months). Beyond 10th month, it increases on regularly, however more slowly, only for ulna and femur. Major increases of breadth measurements take place between the 5th and the 7-9th months depending upon the skeletal element chosen, then they stop growing. Only the scapula collar and the humerus shaft breadths significantly grow on at least until 2 years.

Data being too few for age classes younger than 6 months, mathematical modelling are all biased by the intrapopulation size variations (mainly due to sexual dimorphism) which become more important than age variations beyond 12 months. Therefore, following results must be considered as preliminary, because the collection has not been completed by some boars younger than 6 months.

Tab. 1 gives however the results of the coefficients of correlation between age and the different measurements for linear, logarithmic and 3rd degree polynomial adjustments. We observe that none of the measurements is better correlated

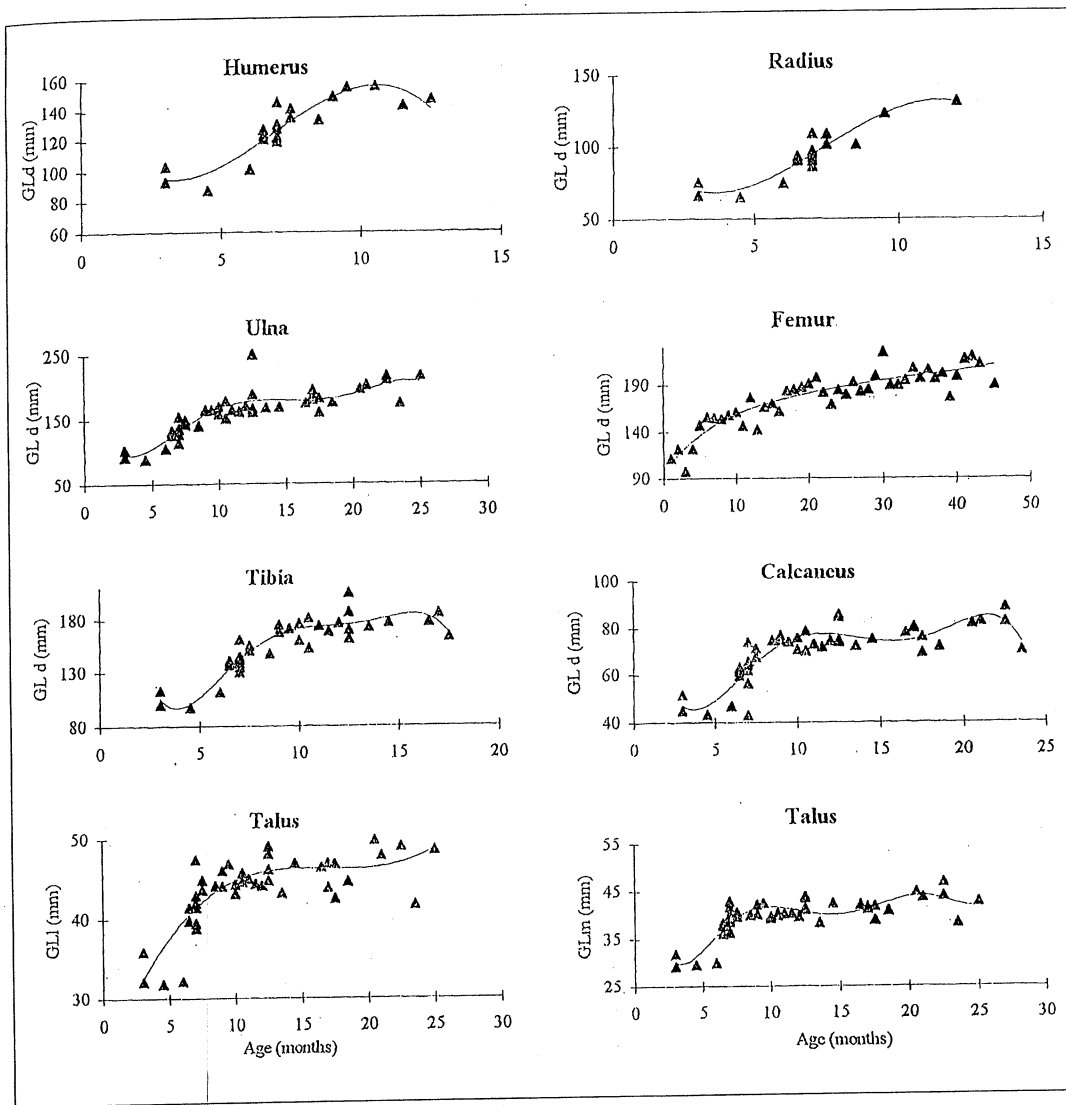


Fig. 1 - Scatter diagrams and 3rd degree polynomial regression between age and length measurements of bones of the present day Oise collection. Abbreviations in text.

with age following a linear model than following a logarithmic one, except radius GL d, probably non significant because only documented by 18 specimens. The logarithmic model fits better than the polynomial one only for 3rd phalange DLS. For all the other measurements, the polynomial model represents the best

adjustment, fitting better and better with increasing polynomial degree. That means that the shape of the polynomial regression on figures 1 and 2 is a good approximation of the actual regression. If considered only between 0 and 10 months, this shape seems to be a logistic one for all the measurements.

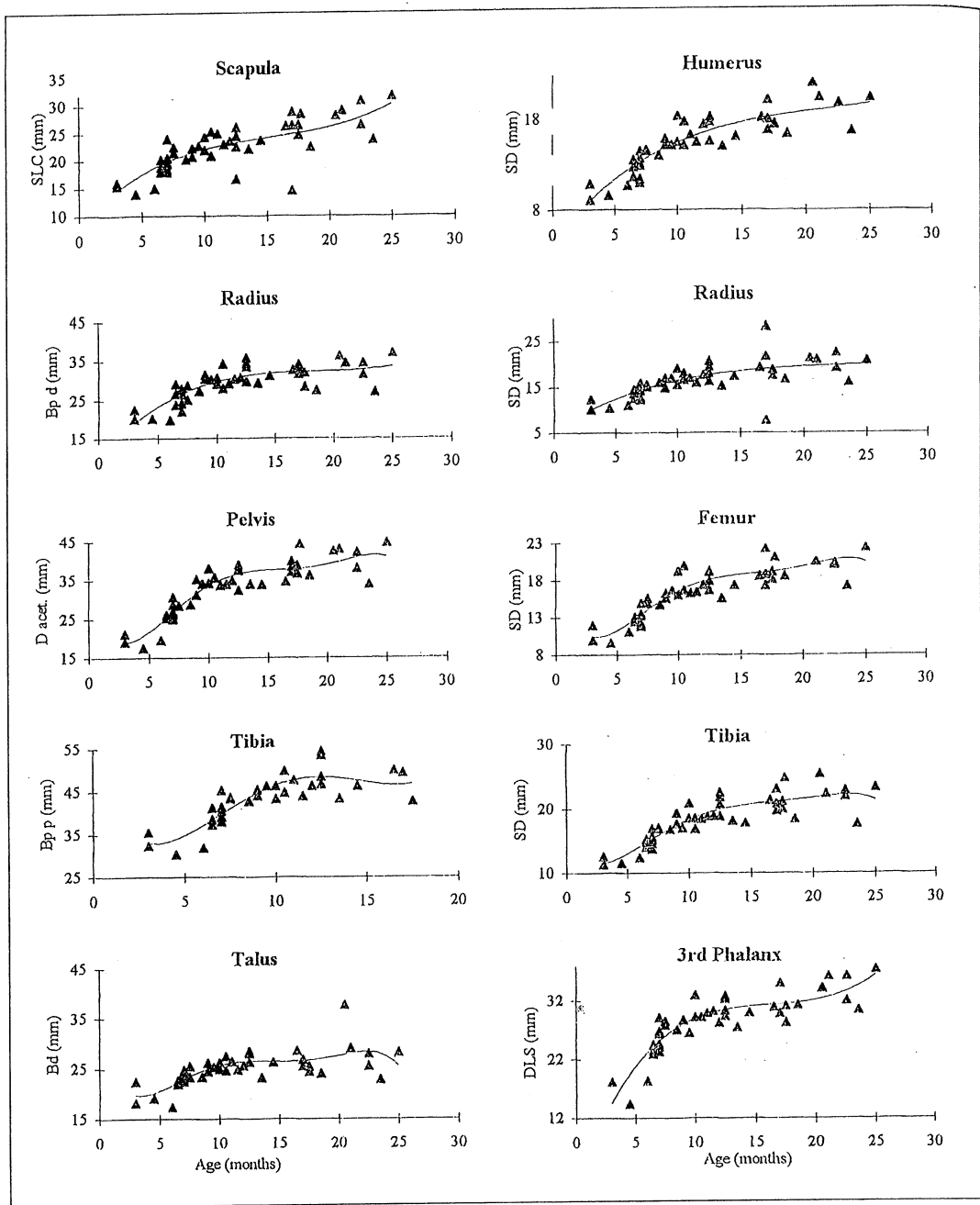


Fig. 2 - Scatter diagrams and 3rd degree polynomial regression between age and breadth measurements of bones of the present day Oise collection. Abbreviations in text.

That means that the best adjustment is probably the logistic one. It is however impossible to test this hypothesis because of the scarcity of animals younger than six months in our reference sample. Here again, results must be considered as preliminary.

Right now, it is however possible to estimate the relative quality for age determination of the different measurements, based on the values of the logarithmic and polynomial correlations. For that, we used an index of relative quality: $IRQ = n - [(R_L + R_P) / 2]$, where n is the number of measurements (15, excepted the less documented, *i.e.* humerus, radius and tibia GL d) and R is the rank to which the measurement appears when all of them are classified following decreasing values of the logarithmic (R_L) and 3rd degree polynomial adjustments (R_P). The IRQ values in table 1 indicate that the measure-

ments better correlated with age, *i.e.* the more accurate for age determination are:

- GL d of femur, ulna and calcaneus,
- D acet. of the pelvis,
- SD of femur and tibia,
- Bp d of tibia,
- DLS of 3rd phalange.

The other measurements seems to be less suitable, but it is impossible to estimate their actual reliability.

2.3 .Conclusion

Although preliminary and of necessity to be strengthened by additional individuals less than 6 months in the reference sample, these results show that it is possible to use shafts growths in breadth and length of ulna, pelvis, femur, tibia, calcaneus and 3rd phalanges, to determine the age of wild boars, especially younger than 10 months of age. These

Measurements	N	Values of the correlation coefficient r			IRQ - Index of Relative quality
		Linear	Log.	3rd ° Polyn.	
Femur GLd	46	0.862	0.904	0.910	14.0
Pelvis Dacet.	45	0.834	0.893	0.907	13.0
Femur SD	47	0.843	0.879	0.889	12.0
Tibia SD	47	0.813	0.864	0.877	11.0
Ulna GLd	47	0.809	0.860	0.871	10.0
3rd Phalange	44	0.783	0.848	0.839	8.5
Tibia Bpd	47	0.745	0.801	0.853	8.5
Calcaneus GLd	44	0.702	0.790	0.829	7.0
Radius Bpd	45	0.698	0.774	0.805	5.5
Talus GLI	45	0.659	0.760	0.811	5.0
Scapula SLC	48	0.752	0.766	0.777	4.0
Talus GLm	45	0.613	0.742	0.799	3.5
Radius SD	46	0.641	0.680	0.687	2.0
Humerus SD	44	0.661	0.665	0.667	0.5
Talus Bd	45	0.595	0.657	0.677	0.5
Humerus GLd	21	0.840	0.852	0.916	
Tibia GLd	35	0.797	0.861	0.900	
Radius GLd	18	0.908	0.856	0.933	

Tab. 1 - Coefficients of correlation between age and the different length and breadth bone measurements for linear, logarithmic and 3rd degree polynomial adjustments, and quantification of the relative quality (IRQ, see mode of calculation in text) of the different measurements for age determination. N, number of measurements.

age classes being the most interesting ones for determining hunting seasons, these results should be useful for archaeology, especially for the European Mesolithic period when wild boar has been one of the most intensively hunted game (Bridault, 1994). As an example of application, we will now try to solve an archaeozoological problem using this method.

3. Archaeological application to the final Mesolithic "Ensemble 3" at Noyen-sur-Seine

3.1. Site, problematic and material

Excavations conducted by Mordant and Mordant (1992) at Noyen-sur-Seine (Seine-et-Marne, Paris Basin) in wet contexts yielded abundant and very well preserved faunal remains from Mesolithic settlements (Marinval-Vigne *et al.*, 1991). Dating to the beginning of the 6th millennium cal. BC, "Ensemble 3" laid at the top of the pity stratigraphic sequence. It yielded 1158 determined bones, with many nearly completely preserved bones. The wild boar is the main species (70% of the NISP), represented by at least 18 individuals. Some bones of the legs have been removed from the site, probably for dried or smoked meat, as well as all the heads. Teeth are therefore absent and only bones can be used for ageing. Well preserved series of different skeletal parts present a large spectrum of growth stages, among which a small group of several unfused bones of the same small size appears quite often, which suggests the dominance of one age class among animals less than 12 months of age.

3.2. Results and discussions

Length and breadth measurements of these bones have been registered following the above cited method, and plotted on the ordinate scale of the reference age-measurement scatter diagrams of figures 1 and 2. Unfortunately, we have no sufficient data for the bones yielding the best age-measurement correlation (see Tab. 1) except for D acet. pelvis. Good results have been gained

however for SD humerus, Bp d radius and GL d tibia (Fig. 3). They show that all the bone series at Noyen are composed of only two size groups, a smaller homogeneous one and a larger more heterogeneous one which includes adult individuals of different size.

The present day Oise collection clearly demonstrates that shaft lengths and breadths are well correlated with age. We can assume that the grouping of the measurements at Noyen "Ensemble 3" reflects a kill off pattern characterized by the absence of very young animals, a single and narrow peak of young ones, a gap between this narrow peak and a rather large group of young adults and adults. Attributing absolute ages to these classes on the base of the Oise collection is more questionable, because of possible differences in the adult body size between the two samples. Fortunately, the largest individuals at Noyen are only a little larger than those from the Oise collection, as shown for four skeletal measurements in figure 3. We can thus use age-measurement regressions of the present day Oise collection for determining the absolute age at death of the Noyen individuals.

Waiting for a better regressive model, we have chosen to use the 6th degree polynomial age-measurement regression, which is the closest to the actual measurements on the present day reference collection. Figure 3 shows that the peak of young individuals at Noyen corresponds with a culling age between 6 and 8 months, and that the smaller values in the larger heterogeneous group of measurements approximately correspond to young adults about 10-11 months. In spite of the very good preservation of bones, there are no individuals younger than 6 months, neither between 8 and 10 months of age.

3.3. Methodological comparison with epiphyseal fusion

We also tried to age these series of bones on the basis of epiphyseal fusion. Taking the proximal radius epiphysis into account, the fusion of which is fast and early in growth (Bridault *et al.*, this volume), we can only

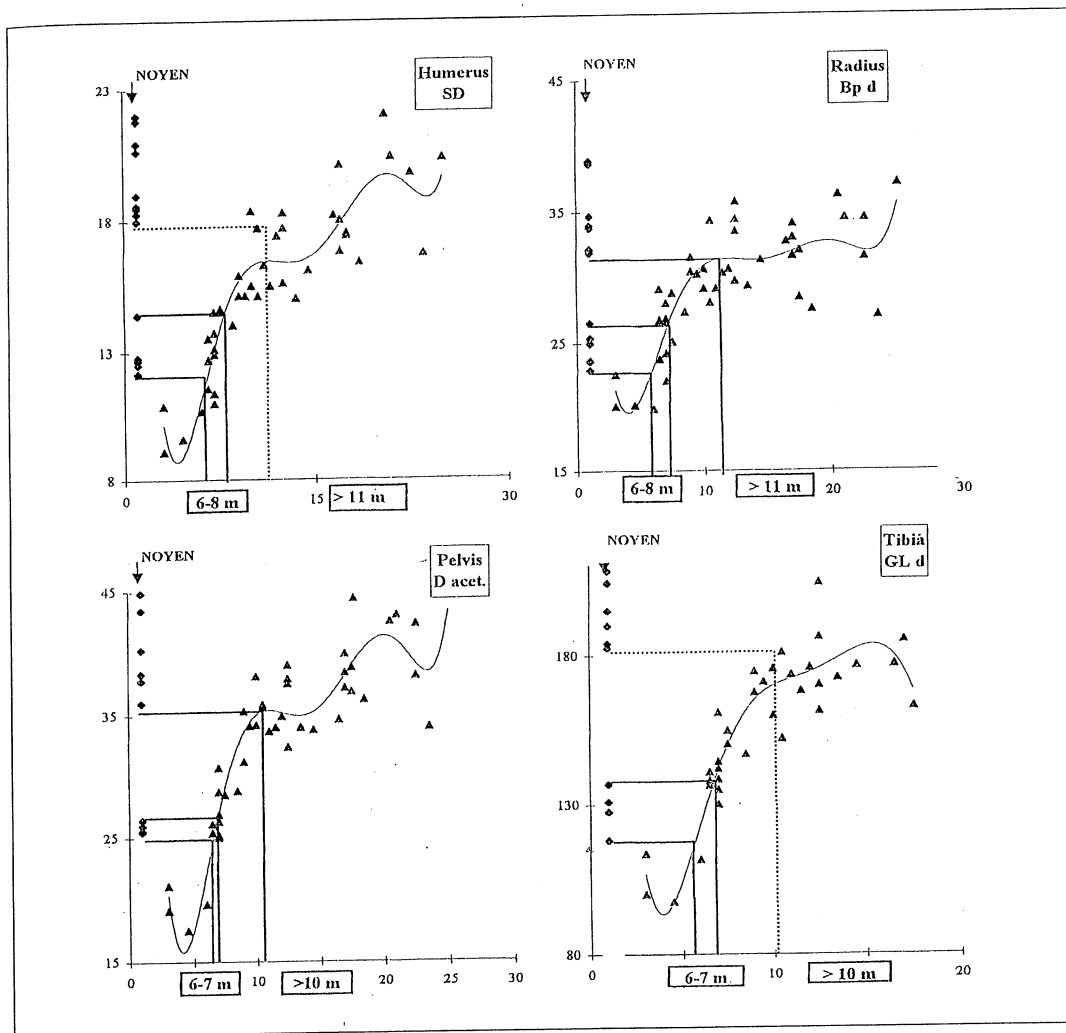


Fig. 3 - Metrical dispersion of four bone measurements in the Mesolithic wild boar collection at Noyen (left margin of the scatter diagrams) and estimation of the corresponding ages according to the 6th degree polynomial age-measurement regression in the present day reference population in the Oise. X-axis: age in months; Y-axis: measurement in mm. For humerus SD and tibia GL d, larger individuals of the Oise collection have been chosen as reference for ages later than 10 months, because of the poor reliability of the regression curve for old ages.

tell that half of bones (*i.e.* 8 out of 17) implicate less than 9-13 months of age, the other half older than 13 months, among which there is one individual between 13 and 42 months, and one older than 42 months. This clearly shows that the measurement method is far precise and powerful than the one based on epiphyseal fusion.

3.4. Interpretation

According to Frädrieh (1974), Mauget *et al.* (1984), Pépin *et al.* (1987) and Bouloire & Vassant (1989), farrowing takes place at the same period and within a rather short period of time (one or two months) for all females in the same population of wild boars. Therefore, the very particular mortality profile of the

wild boars at Noyen "Ensemble 3", with only one narrow age class in the young boars, excludes the possibility of hunting at different seasons. On the contrary, it suggests only one short hunting season or several ones always situated at the same season of the year. This explains why the faunal assemblage is relatively small in number of bones and individuals and is highly dominated by the wild boar (the other Mesolithic levels having mainly yielded red deer): the site has been occupied for short hunting session, probably focussed on wild boar hunting.

The biological literature also indicates that, waiting for the next farrow, which can take place 5 to 10 months later, young wild boars from the last farrow together with some of the female specimens from the preceding ones, remain with the females and constitute altogether small groups, adult males being generally more isolated. At Noyen, the presence of 6-8 month old boars together with animals older than 10 months and with a few adults suggests that Mesolithic people hunted groups of animals rather than isolated ones. This probably corresponds to collective drives or corral hunting.

Determining the hunting season is more difficult, because wild boars can farrow once in a year, between March and June, either twice, from December to February-March and from July to September.

Depending on these possibilities, the 6-8 month old animals at Noyen could have been killed somewhere between August to February (late summer-fall-early winter), from May to October (spring-summer) or from December to May (winter-spring), respectively. That covers all seasons of the year. It could be possible to eliminate one or two of these possibilities at Noyen, taking the 10-11 month age class just after the 8-10 month gap in the mortality profile into consideration. Before trying, it seems necessary first to strengthen reference data and to establish accurate modeling for the present day Oise collection. However, it must be noticed that in the same layer, the season for fishing and deer hunting have

been determined as late summer (August to October; Dauphin, 1987; Vigne, *unpubl.*), but these activities must not necessarily have happened contemporaneously with wild boar hunting.

4. General conclusion

More numerous complete skeletons of boars of the same Oise population must be collected, especially younger than 6 months, in order to make this reference collection becomes completely useable. At the present state of its constitution and analysis, it appears however that data on bone measurements are nearly as good and useful as data on tooth eruption and wear for determining age pattern of wild boar in archaeological assemblages.

Attributing absolute ages to the relative age pattern is more questionable, even if in the present case at Noyen, fortunately, the adult size could be considered as similar to one of the reference Oise collection. Adult size of bones actually determines the shape of the growing curve of each bone measurement, which may invalidate the use of the Oise collection for all archaeological examples where wild boar, too, would be either much smaller or larger than the present day Oise reference collection. However, comparisons of size differences at birth in populations of domestic pigs of very different adult skeletal sizes (see *e.g.* Quitter & Zert, 1971) suggest that metrical differences between shaft lengths and moreover breadths of two boar populations which differ by their mean adult body size are decreasing when considering younger animals. From the impact of the adult body size decreasing in younger age classes, it seems however possible, basing on the Oise reference collection, to estimate absolute ages for any wild boar archaeological assemblages with a good reliability, except for individuals more than 10-12 months. Like for the other ageing classes, the reliability of the bone measurement method thus decreases rapidly with age, the more rapidly for suids that their growth is much shorter in time than the ones of the ruminants.

Anyway, when considering only the post-cranial skeleton, using bone measurements appears to be the best ageing method, much more precise and accurate than using epiphyseal fusion.

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