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To cite this version:
Charlotte Leduc, Anne Bridault, Christophe Cupillard. Wild boar (Sus scrofa scrofa) hunting and exploitation strategies during the Mesolithic at Les Cabônes (Ranchot Jura, France), layer 3. Journal of Archaeological Science: Reports, Elsevier, 2015, 2, pp.473-484. 10.1016/j.jasrep.2015.05.010. halshs-01684601

HAL Id: halshs-01684601
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Wild boar (*Sus scrofa scrofa*) hunting and exploitation strategies during the Mesolithic at Les Cabônes (Ranchot Jura, France), layer 3

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1. Introduction

In recent decades, archaeofaunal studies have demonstrated the importance of wild boar (*Sus scrofa scrofa*) in the subsistence economy during most of the Mesolithic period in Northern and Eastern France and in western Switzerland.

In assemblages dated 9500–7000 cal BC in the Jura area, wild boar and red deer (*Cervus elaphus*) are almost always the two main hunted species, as exemplified at the following sites: Rochedane, layer A3 and Mannleifelsen I, layers Q–L (Bridault, 1990, 1993); Bavans layer 6 (Aimé, 1993); Chaisey, level C2, and Ruffey-sur-Seille, levels R4, R3 and R2 (Séara et al., 2002); Dammartin-Marpain, locus 1 to 16 (Leduc in Séara and Roncin, 2010; Séara and Roncin, 2013); Mollendruz, layer 4d (Chaix in Pignat and Winiger, 1998); Ogens, layers C2 to C13–14 (Bridault and coll. P. Chiquet, 2000); Birsmatten, levels H5–H3 (Schmid, 1963) (Fig. 1).

At the present time, it is clear that in northern France, where numerous sites are located in the Seine and Somme valleys and its tributaries, wild boar became dominant in the assemblages dated between 8600 and 7800 cal BC (Marinval-Vigne et al., 1989; Bridault, 1997; Ducrocq et al., 2008, 2014; Coutard et al., 2010; Séara et al., 2010; Bignon-Lau et al., 2013; Leduc et al., 2013).

Despite the apparent importance of the wild boar in the subsistence economy of these Mesolithic groups, the hunting strategies and exploitation patterns involved are still only sparsely documented. One of the authors (AB) has stressed that wild boar hunting at Rochedane was focused on the primary social group (Bridault, 1993: 486–490, 1994: 63), i.e. a few sows, their last litters and juvenile offspring of previous litters (Mauget, 1981). It was also suggested that hunters could thus take advantage of targeting several animals at once. Such groups are the most easily located, as their mobility is more circumscribed than solitary males, and encountered more frequently, as they often take the same routes when wandering (Mauget, 1981).

The abundant boar remains, including a high proportion of teeth, identified in the Mesolithic assemblage from layer 3 at Les Cabônes rockshelter (Ranchot, Jura) (Fig. 1), offered the opportunity to study the hunting strategies and carcass exploitation patterns at this site. The analysis was done as part of a Master’s thesis (Leduc, 2005). The present paper addresses these issues, with an emphasis on the reconstruction of age-at-death distributions, i.e., mortality profiles.
2. The site

Les Cabônes rockshelter, also called “Abri du Colonel Martin”, is located near the town of Ranchot (Jura), midway between Besançon (Doubs) and Dole (Jura) (Fig. 1). It is situated on the right bank of the Doubs River, very close to the river, at an altitude of 216 m. The cavity is quite small, 5 m deep, 4 m wide and 2.5 m high, oriented south-west and opening onto a wide rockshelter ca. 10 m long (Cupillard, 1998a, 2002, Fig. 2).

Following test excavations during the 1950s and 1960s, large-scale excavations were undertaken from 1978 to 1989, directed by A. Thévenin, M. Campy, S. David and C. Cupillard (David, 1996; Cupillard, 1998a; Cupillard and David, 1991, 1995; Cupillard and Richard, 1999). The stratigraphy contains four main layers with an Upper Magdalenian occupation in layer 4 (David, 1996; D’Errico and David, 1993; Cupillard, 1998a) and several Mesolithic occupations in layer 3 and the lower part of layer 2 (Fig. 3).

Layer 3 is 60 to 70 cm thick and was excavated over a surface area of 50 m² but probably covers 80 m² into the rockshelter, as suggested from test excavations. Its preservation is irregular depending on topography and the sectors excavated. The layer is absent in the cave where it was destroyed by old excavations while it is well-preserved between the
overhanging cliff and the river. In this zone, the layer was locally disturbed to varying extents by old badger holes which were easily identified during excavation.

Overall, layer 3 yielded abundant archaeological remains (Fig. 4), including a rich and varied lithic industry with many microliths (Roué, 2000), a very large collection of mammal bones and fish bones (Frontin, 2008) as well as bone and antler tools (Cupillard, 1998b), personal ornaments (Cupillard, 1998c) and human bones (Valentin, 1998).

In layer 3, the detailed study of a large assemblage of microliths (more than 820) indicates that the Mesolithic occupations belong to different cultural phases: the end of the Early Mesolithic (Early Mesolithic with segments) located in the lower part of the layer; the Middle Mesolithic in the main part of the layer (Sauveterrian technocomplex) and finally the Late Mesolithic which is minimal and only documented at the top of the layer (Cupillard, 1998a; Roué, 2000).

Eleven radiocarbon dates are available for layer 3, five of which are AMS dates, all of which are presented in this paper. AMS dates were obtained recently on well-identified bones of red deer, lynx and badger, but the last should be excluded as it corresponds to an intrusive Neolithic specimen (Table 1). The four other AMS radiocarbon dates on bone date the layer between 8200 and 7100 cal BC, 2σ. If only dates on ungulates (red deer) are considered, then the average date provides an age between 8200 and 7300 cal BC (Table 1), i.e., between the end of the Preboreal and the beginning of the Atlantic period.

The large thickness of layer 3, variation in the microlith spectrum from the base to the top of the layer, and the results of AMS radiocarbon dates indicate a cumulative archaeological unit, sensu Brochier (1999) rather than a single event. At present, the duration and frequency of the Mesolithic occupations at Les Cabônes constitute an open question subject to ongoing research. While the overall homogeneity of the lithic industry allows us to consider this layer as representative of repeated occupations by the same cultural groups during the Boreal period, the uncertainty regarding patterns and duration of occupation should be kept in mind in the discussion (see below).

3. The material

A former preliminary study of faunal remains was conducted immediately after excavation (Auguste, 1990). For Mesolithic layer 3, more than 4000 bone fragments were counted at that time and 2680 identified to species (Table 2). The faunal spectrum included twelve species, wild boar being the first species with 1210 identified remains (45% of
the NISP). This first result and the importance of the species in the regional Mesolithic economies motivated the present analysis centered of the wild boar hunting strategies.

The work conducted by one of the authors (CL) complemented the initial sample studied for layer 3, increasing the number of identified wild boar remains to 2989, thus confirming the importance of this species in the faunal spectrum, together with red deer. This faunal material is quite abundant in comparison with the other Mesolithic assemblages. Wild boar remains are present throughout layer 3, without any visible spatial organization. Like other faunal remains, they are distributed homogeneously (vertically and spatially) among the square meters excavated in layer 3. These remains are also very well-preserved although fragmented. Exhaustive sieving using successive several size mesh (from 10 mm to 1 mm) resulted in the recovery of the smallest bone fragments and elements (sesamoids, deciduous teeth, etc.). Teeth (N = 705) account for 23.6% of the wild boar remains (Table 3). Although complete jaws are not represented in this assemblage, portions with several teeth (N = 179) and isolated teeth (N = 526) are well-preserved, and include deciduous canines and incisors (Fig. 5) as well as tooth buds/germs. Such characteristics make this an important archaeofaunal assemblage to investigate hunting strategies.

### 4. Method

To construct age-at-death distributions, i.e., mortality profiles, aging methods based on tooth eruption and wear stages were used, being the most reliable and precise. Estimations of age are largely conditioned by the validity of the reference data, an important point that needs to be presented prior to the analysis (see below: Section 4.1). Following the selection of reference data, specific methodological issues are discussed, such as the importance of taking into account isolated teeth and the means to reconstruct theoretical individuals.

#### 4.1. Modern pig referentials of tooth eruption and use-wear patterns

Many studies have been published on tooth eruption in European and Asian pigs, both domestic (e.g., McCance et al., 1961; Higham, 1967; Silver, 1969; Habermehl, 1975) and wild (Matschke, 1967; Briedermann, 1967; Kozlo and Nikitenko, 1967; Diong, 1973; Varin, 1977; Hayashi et al., 1977; Iff, 1978; Bull and Payne, 1982; Habermehl, 1985; Genov et al., 1992; Boitani and Mattei, 1992; Rowley-Conwy, 1993; Rolett and Chiu, 1994; Baubet et al., 1994; Bridault et al., 2000; Magnell, 2006a,b; Carter and Magnell, 2007; Magnell and Carter, 2007; Anezaki, 2009; Lemoine et al., 2014) or both (Legge, 2013), that may be applied in archaeology. Data for tooth eruption in pigs may vary between different authors (e.g., Bridault et al., 2000; Genov et al., 1992). This important point was further recently synthesized in a review (Legge, 2013) showing clearly that such discrepancies reflect in part variability of tooth eruption ages between different populations of pig (wild, feral, domestic), and in part criteria selected by different authors to record tooth eruption. For instance, the M2 age range is 9 to 12 months in domestic pigs and 12 to 14 months in wild boar. Similarly, M3 eruption ages are earlier for domestic pigs than for boar. Tooth eruption is a process that may last several weeks or months between the emergence of the tooth through the bone, through the gum and its full eruption. Some authors consider the initial phase of eruption, when the tooth breaks through the gum (Matschke, 1967: 109; Magnell, 2006a), corresponding, for the molars, to the primary, secondary and tertiary eruption (Higham, 1967; Rowley-Conwy, 1993). Carter and Magnell (2007: Magnell and Carter, 2007) prefer to refer to tooth

### Table 2

<table>
<thead>
<tr>
<th>Taxa</th>
<th>NISP</th>
<th>%NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild boar <em>(Sus scrofa scrofa)</em></td>
<td>1210</td>
<td>45.15</td>
</tr>
<tr>
<td>Red deer <em>(Cervus elaphus)</em></td>
<td>1039</td>
<td>38.77</td>
</tr>
<tr>
<td>Roe deer <em>(Capreolus capreolus)</em></td>
<td>164</td>
<td>6.12</td>
</tr>
<tr>
<td>Beaver <em>(Castor fiber)</em></td>
<td>103</td>
<td>3.84</td>
</tr>
<tr>
<td>Badger <em>(Meles meles)</em></td>
<td>35</td>
<td>1.3</td>
</tr>
<tr>
<td>Aurochs <em>(Bos primigenius)</em></td>
<td>34</td>
<td>1.27</td>
</tr>
<tr>
<td>Fox <em>(Vulpes vulpes)</em></td>
<td>25</td>
<td>0.93</td>
</tr>
<tr>
<td>Pine marten <em>(Martes martes)</em></td>
<td>16</td>
<td>0.6</td>
</tr>
<tr>
<td>Wolf <em>(Canis lupus)</em></td>
<td>18</td>
<td>0.67</td>
</tr>
<tr>
<td>Wild cat <em>(Felis sylvestris)</em></td>
<td>15</td>
<td>0.56</td>
</tr>
<tr>
<td>Lynx <em>(Lynx lynx)</em></td>
<td>1</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2680</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

### Table 1

<table>
<thead>
<tr>
<th>Sample dated</th>
<th>Age BP</th>
<th>Cal BC, 2s</th>
<th>Reference lab.</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone, red deer</td>
<td>8840 ± 60</td>
<td>8219–7749</td>
<td>GR-A-21529</td>
<td>Drucker et al. (2008)</td>
</tr>
<tr>
<td>Bone, red deer</td>
<td>8570 ± 60</td>
<td>7724–7582</td>
<td>GR-A-21524</td>
<td>Drucker et al. (2008)</td>
</tr>
<tr>
<td>Bone, red deer</td>
<td>8380 ± 45</td>
<td>7542–7341</td>
<td>GR-A-23149</td>
<td>Drucker et al. (2008)</td>
</tr>
<tr>
<td>Bone, lynx</td>
<td>8160 ± 95</td>
<td>7300–7061</td>
<td>GR-A-38027</td>
<td>Cupillard et al. (in press)</td>
</tr>
</tbody>
</table>

**Fig. 4.** Excavation of “Les Cabônes” rockshelter (1988). Detail of excavation in layer 3 with bones and wild boar tusk. © C. Cupillard.

**Fig. 5.** Excavation of “Les Cabônes” rockshelter (1988). Detail of excavation in layer 3 with bones and wild boar tusk. © C. Cupillard.
development, i.e., stages from crown formation into the jaw to root enclosure. Such a method is particularly useful to provide precise eruption stages for isolated teeth. Particularly striking is the case of M3, a three cusp tooth: 3 months when the start of the process is only considered (Matschke, 1967) or up to 17 months, when full eruption is taken into account (Magnell, 2006a,b; Carter and Magnell, 2007; Magnell and Carter, 2007).

Finally, G.H. Matschke’s referential stands as the most complete, based on a large and detailed data-set, dealing with about 200 individuals of different ages, progeny of wild boars captured in Europe and reared in Tennessee (Matschke, 1987). Moreover, this is the only referential in which absolute eruption age (with mean and range) is given for every upper and lower tooth. It has been tested and largely confirmed by application to modern and archaeological samples (Baubet, 1998; Bridault et al., 2000; Magnell, 2005, 2006a,b; Carter and Magnell, 2007; Magnell and Carter, 2007; Legge, 2013; Lemoine et al., 2014).

Based on radiographs of the lower jaws of wild boar and crossbred pigs, Magnell and Carter’s study confirms the eruption stages given by Matschke and clarifies the timing for M3 eruption: mesial cusp between 19 and 24 months; distal cusp between 25 and 36 months (Carter and Magnell, 2007). Both referentials (Matschke, 1967; Carter and Magnell, 2007) were used in the present work (Table 4).

Aging from tooth wear patterns is appropriate for adult animals with full permanent dentition, i.e. when M3 is fully erupted, over 36 months (Carter and Magnell, 2007). Data-sets dealing with use-wear for pigs are, however, less numerous (Kozlo and Nikitenko, 1967; Higham, 1967; Habermehl, 1975; Varin, 1977; Iff, 1978; Grant, 1982; Briedermann, 1967; Rowley-Conwy, 1993; Rolett and Chiu, 1994; Horard-Herbin, 1997; Wright et al., 2014). Information on the size of the corpus and the population studied are often lacking and in the main studies, some age groups are less represented, specifically older groups.

Grant’s method (Grant, 1982), based on tooth wear coding, is widely used in archaeozoological studies. This provides a technique to accurately record dental wear stages for lower cheek teeth in pig, although it does not allow estimation of absolute ages. Magnell (2006a) tested this method on present-day wild and crossbred boar from five different populations (Poland, Germany and Sweden), demonstrating a strong correlation (regression line and scatterplot of MWS versus age) between Grant’s wear stages and age, at least for individuals up to 36 months old. Observing early use-wear patterns for wild boar of known age, with dentition that is not fully erupted, he noted low asymmetry in wear patterns on left and right mandibles of single individuals, as well as little variation between individuals of the same age stage up to 36 months, a fact recently confirmed (Lemoine et al., 2014). But for older individuals, tooth wear patterns observed in present-day wild boar over three years of age can exhibit marked variation between individuals in the same age class and between different populations (Habermehl, 1985; Grant, 1978, 1982; Bull and Payne, 1982), mostly dependent on feeding habits (McCance et al., 1961; Grant, 1978, 1982). However, as mentioned above, this pattern is not clearly detailed as older individuals are often less represented in referential data. Estimation of age in adult animals is thus less precise (2 to 3 age classes) and more difficult, especially when jaw remains are fragmented.

In the present work, the wear-pattern for each isolated tooth or mandible fragment of adult animals was recorded, based on Grant’s

---

**Table 3**

Distribution of wild boar teeth in age groups from “Les Cabônes” rockshelter.

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Isolated teeth</th>
<th>Mandible or Maxillary fgts</th>
<th>Total of tooth remains</th>
<th>% of isolated teeth</th>
<th>MNI without isolated cheek &amp; front teeth</th>
<th>MNI with isolated cheek teeth</th>
<th>MNI all teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cheek</td>
<td>Front</td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–6 months</td>
<td>27</td>
<td>89</td>
<td>116</td>
<td>11</td>
<td>127</td>
<td>91.3</td>
<td>4</td>
</tr>
<tr>
<td>6–12 months</td>
<td>20</td>
<td>101</td>
<td>121</td>
<td>11</td>
<td>164</td>
<td>73.8</td>
<td>6</td>
</tr>
<tr>
<td>12–18 months</td>
<td>18</td>
<td>79</td>
<td>97</td>
<td>15</td>
<td>112</td>
<td>86.6</td>
<td>2</td>
</tr>
<tr>
<td>18–24 months</td>
<td>5</td>
<td>36</td>
<td>41</td>
<td>13</td>
<td>54</td>
<td>75.9</td>
<td>3</td>
</tr>
<tr>
<td>24–36 months</td>
<td>10</td>
<td>30</td>
<td>40</td>
<td>14</td>
<td>54</td>
<td>74.1</td>
<td>2</td>
</tr>
<tr>
<td>3–5 years</td>
<td>14</td>
<td>41</td>
<td>55</td>
<td>37</td>
<td>92</td>
<td>59.8</td>
<td>7</td>
</tr>
<tr>
<td>5–7 years</td>
<td>5</td>
<td>36</td>
<td>41</td>
<td>42</td>
<td>83</td>
<td>49.4</td>
<td>4</td>
</tr>
<tr>
<td>7–10 years</td>
<td>6</td>
<td>9</td>
<td>15</td>
<td>4</td>
<td>19</td>
<td>78.9</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>421</td>
<td>526</td>
<td>179</td>
<td>705</td>
<td>74.6</td>
<td>29</td>
</tr>
<tr>
<td>Total %</td>
<td>20</td>
<td>80</td>
<td>100</td>
<td></td>
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</tr>
</tbody>
</table>
method and assigned to age ranges of 3–5 years; 5–7 years and 7–
10 years following various publications (Habermelh, 1975; Varin,
1977; Iff, 1978). Life expectancy of modern wild boar is between 10
and 15 years (Ettienne, 2003; Varin, 1980; Habermelh, 1975). Here, a
10-year life span was used, as no teeth remains with extreme wear
were recorded in the assemblage. In a recent article, Lemoine et al.
(2014) devised a scoring system for individual teeth from prior to
formation through heaviest wear, adapted from Grant’s wear stages
and based on clear and efficient recording rules. We tested this
system on a Ranchot subsample of adult mandibles of different ages.
The results show a generally good match in the estimate of ages be-
tween this system and the one we initially used. Slight discrepancies
can nonetheless be noted: our 5–7 year age group corresponds to the
4.5–6 year age group in the Lemoine system; and individuals we
assigned to the 7–10 year old group fall in the 7–8 year age group in
the Lemoine system, thus confirming the absence of very old hunted
animals at Ranchot.

Finally, age attribution for teeth from Les Cabônes was based on
Matschke’s (1967) and Carter and Magnell’s (2007) eruption stages,
and correspondence between detailed use-wear patterns (Grant,
1982) and defined age groups (Habermelh, 1975; Varin, 1977; Iff,
1978).

4.2. The importance of including isolated teeth

As is the case here, isolated teeth are often predominant among ar-
chaeological assemblages, but are rarely included in age attribution
studies (Rolett and Chiu, 1994; Magnell, 2005, 2006a,b; Haber,
2007; Magnell and Carter, 2007). However, they ensure better representation,
notably of very young individuals (from birth to 12 months) whose jaws
are more sensitive to breakage and destruction. Including or excluding
isolated teeth from a study may significantly modify mortality profiles
and, consequently, interpretation of hunting strategies, making it a cru-
cial methodological issue. In a recent study, mortality profiles were re-
constructed for wild boar from three different archaeological samples,
using different samples of teeth, including or not maxillary tooth rows
or loose teeth. While general profiles remain the same, it appears that
using maxillary remains provides better representation of adult individ-
uals while the use of loose teeth is essential for juvenile individuals
(Lemoine et al., 2014). In the present assemblage, isolated teeth are pri-
marily front teeth (80%) while cheek teeth are mainly premolars
(Table 2). Isolated deciduous teeth are quite common and this is espe-
cially important to consider as juvenile individuals are represented by
fewer teeth than adults and their teeth are more fragile (Monson and
Gamiewicz, 2003).

4.3. Searching for individuals

The reconstruction of age-at-death distributions (mortality profiles) in
the present study begins with the detailed examination of each tooth-
mandibular and maxillary remain and their precise identification, in
order to sort them up into upper/lower and right/left remains. Second,
the eruption/wear stage is recorded for each dental remain (either iso-
lated or set in the jaws), following the referential data outlined above.
Third, we assign age ranges to these remains, with larger age ranges
for isolated permanent worn teeth. Fourth, we attempt to refit mandible
or maxilla fragments and isolated upper and lower teeth as much as
possible. Fifth, we match left and right-lower and upper elements of
the same age ranges, based on idiosyncratic patterns of wear and sexing,
in order to reduce double counting and estimate the minimum number
of individuals. Sexing the remains by the morphology of the canines as
well as the socket when the tooth is missing (Schmid, 1972; Mayer
and Brisbin Lehr, 1988) refines the identification of the individuals.
The estimated Minimal Number of Individuals, here based on age
dental development and wear), sex, size differences, patterns of
wear, pairing (left and right halves) and matching (upper and lower),
is greater than the MNE (complete jaws) determined with consider-
ation of type of teeth and side only. The MNI is thus closer to the initial
number of individuals that contributed to the assemblage (Poplin,
1976a,b). Finally, the construction of mortality profiles may be realized
by including the number of teeth or the number of individuals per age
class.

5. The wild boar age mortality profile for Les Cabônes, layer 3

A total of 705 dental elements (NISP) and fifty individuals have been
distributed into eight age classes (Table 3; Figs. 5–7).

- 0 to 6 months: NISP = 127 dental remains, MNI = 11. Two are peri-
natal individuals, whose deciduous molars exhibit very slight
wear and the presence of a first molar bud. Five individuals with unerupted
M1 (in crypt), are 2–4 months old.
- 6 to 12 months: NISP = 164, MNI = 12. These individuals were
mostly estimated by upper teeth. 7 individuals with unworn M1
may be aged between 6 and 7 months.
- 12 to 18 months: NISP = 112, MNI = 6. Most of these individuals
(n = 5) have unworn upper M2 with incomplete roots and perma-
nent premolar buds and can be aged between 12 and 15 months.
- 18 to 24 months: NISP = 54, MNI = 3.
- 24 to 36 months: NISP = 54, MNI = 3–2 females and 1 male. This
age group is the first with individuals having complete permanent
dentition. Most have all their teeth in wear, except for the youngest
one with M3 in early erupting stage.
- 3 to 5 years: NISP = 92, MNI = 9, including 3 females and 1 male.
- 5 to 7 years: NISP = 83, MNI = 4, including 2 females and 2 males.
- 7 to 10 years: NISP = 19, MNI = 2 males. These are the oldest indi-
viduals of the assemblage with all teeth worn.

Fig. 8 shows a graphic representation of the age-at-death frequency
distribution, based on corrected data (Table 5). In the histogram, the fre-
cuencies of each age class are proportional to the area of each bin and
are calculated by dividing the relative frequency by the bin width of
each age class (Brochier, 2013).

As stated above, isolated teeth were included in the analysis leading to
the mortality profile (Fig. 8). Exclusion of such remains lead, as expected
(Lemoine et al., 2014), to the underrepresentation of younger individuals,
as shown in Fig. 9. It is particularly striking here for the
0–6 months and 12–18 months groups, for which the numbers of indi-
viduals more than doubled (4 to 9 and 2 to 5, respectively) as younger
age groups are documented predominantly by isolated teeth: 91.3%
for 0–6 months; 73.8% for 6–12 months (Table 3; Figs. 8 & 9). An in-
creasing representation of individuals can also be observed regarding
individuals up to 3 years, thus including the young adult age groups.
After the age of five years, the inclusion of isolated teeth no longer in-
creases the number of individuals.

Eventually, all age groups are present in the wild boar mortality pro-
file at Les Cabônes (Fig. 8), but in different proportions. The predomi-
nance of juvenile individuals should be noted: 64% of the individuals
(32 individuals) are less than 2 years old. The youngest age groups are
particularly well-represented: 22% of the hunted wild boar are less
than 6 months old (MNI = 11), 24% from 6 months to 12 months old
(MNI = 12) and 12% from 12 to 18 months old (MNI = 6). Adults
over two years old are present but in lower proportions (36% of the in-
dividuals) and are mostly young adults from 2 to 5 years old. Only two
individuals older than 7 years old have been identified, based on third
molar use-wear patterns. For these, both third molars are not deeply
worn, referring to Grant’s stages e/f and g, probably indicating a position
at the beginning of this last age group.

As the main goal of the original study (Leduc, 2005) focused on mor-
tality profiles, the entire assemblage of wild boar teeth was studied,
making it possible as well to reconstruct hunting strategies.
6. Discussion

The duration and frequency of the Mesolithic occupation (layer 3) at Les Cabônes are not known for certain and may be the result of repeated and cumulative occupations. In this perspective, establishing the wild boar hunting season(s) is relevant to clarify the period(s) and/or rhythm of site occupation. This is, however, quite difficult to ascertain. First, present-day wild boar birth periods in France range from January to September, even if the majority of births occur between March and June (Lauwerier, 1983; Mauget et al., 1984; Boitani et al., 1995a,b). Moreover, two birth patterns, per year, can occur in a single population: a uni-modal type (one litter), with females giving birth mostly from March to June (Lauwerier, 1983; Mauget et al., 1984; Boitani et al., 1995a,b). However, two birth patterns, per year, can occur in a single population: a uni-modal type (one litter), with females giving birth mostly from March to June (Lauwerier, 1983; Mauget et al., 1984; Boitani et al., 1995a,b). Such variability depends on several parameters: geographic, climatic and above all food availability and good conditions increasing farrows (Lauwerier, 1983; Mauget et al., 1984; Baubet, 1998; Pépin, 1991; Santos et al., 2006). Consequently, considering the youngest individuals of the assemblage with very precise ages, up to 7 months (cf supra 5: five individuals aged between 2 and 4 months, and seven individuals between 6 and 7 months) and the two farrowing patterns to infer seasons of mortality, piglets could have been hunted at many different times of the year. Following the uni-modal type, hunting episodes could have occurred from May to October (minimum) or from March to January (maximum). The bi-modal type could reflect hunting episodes in March (in accordance with all individuals), but this could rather also reflect hunting episodes almost all year-round, from January to October (Fig. 10). It is therefore not possible to clearly resolve the question of seasonality of occupation at Les Cabônes. Very strict seasonal hunting episodes cannot be excluded, and possibly separated by long times without occupation, although several hunting seasons are quite probable based on very precise young ages, and the presence of other age groups (12–18 and 18–24 months). Admitting this, and considering the corpus as representative of hunting

Fig. 6. Example of teeth from "Les Cabônes" rockshelter distributed in different age groups: A & B: 0–6 months; C: 6–12 months; D: 18–24 months; E: 24–36 months. © A. Bridault.
strategies developed by cohesive Mesolithic groups, how can these strategies be described?

The high proportion of piglets (22%, less than 6 months old), juveniles (24%, 6–12 months) and individuals from 1 to 2 years old (18%) in addition to young adult females (7 individuals — Table 3; Fig. 8), indicates that typically sounders, i.e., sows and their offspring, were regularly hunted. Sounders form social groups of 10–20 individuals (Vassant et al., 2010) led by an old matriarch. They include barren sows and mothers with juveniles from the previous litter. Subadult males are driven out of the sounder at the age of 9–13 months (Bouldoire and Vassant, 1989: 88–89) and form loose groups, while adult and elderly males tend to be solitary most of the year. Sounders form a stable social group outside the breeding season. They move around in a more circumscribed area than solitary males, following paths (Bouldoire and Vassant, 1989; Vassant et al., 2010) mostly during the night (Mauget, 1984); consequently their encounter rate is higher. They are also easier to locate as they are noisy. Hunting sounders also offers the advantage of killing several animals at the same time. But due to the high proportion of hunted juveniles at Ranchot, which are less bulky than adults, such hunting was not the most effective in terms of net returns. However, it cannot be excluded that the occupants of the rockshelter also hunted solitary males, although occasionally, as adult males have been identified (5 individuals over 3 years old — Table 2; Fig. 8). Hunting adult males involves different tactics as boars are more difficult to track and can be dangerous. While time and pursuit costs may be higher and hunts riskier, males provide the highest caloric return. But other goals, such as the acquisition of tusks, may account for hunted males. Indeed, some tusk fragments found on the site are most likely fragments of tools. One has longitudinal flaking scars and the occlusal surface scraping marks (Fig. 11). Another one has scraping marks and a polished surface. Tools made from wild boar tusks are known from this geographic area during the Mesolithic, at La Baume d’Ogens (Vaud canton, Switzerland) and Birsmatten-Basisgrotte (Bern canton, Switzerland) (David, 2000) and during the Mesolithic in general (Marquebielle, 2014).

The results from Les Cabônes layer 3, based on a large sample, confirm the hunting of sounders as previously pointed out at the site of Rochedane (Douds), located in the same region (Bridault, 1993, 1994). At Rochedane, boar exploitation was coupled with selective red deer hunting, targeting adults, mostly stags, which was interpreted as a high risk strategy maximizing net returns (ibid.). Thus, the acquisition of the two key game species was based on complementary strategies. This may be the case at Les Cabônes, but results for red deer exploitation are not yet available. Nonetheless, it is clear that the acquisition of wild boar at Les Cabônes 3 was based on different hunting episodes targeting different social groups and/or individuals. Sounder hunting ensures a steady food supply (including tender meat from piglets). Hunting of occasional solitary males would certainly provide a greater quantity of meat and grease per capita, but also ivory. Tusks were likely items sought-after for their technical properties and/or because they would be socially valued. Such a strategy would have also involved different hunting tactics (approach, beating, ambush, etc.).

7. Conclusion

The meticulous recovery techniques used during excavation and the good preservation of the faunal material from layer 3 of Les Cabônes rockshelter offered the opportunity to analyze a large sample of boar.
remains to reconstruct the hunting strategies for one of the key resources during the Mesolithic period.

Boar populations were likely abundant in the region during the period of site occupation (8200–7300 cal BC). Preying on sounders, the main social group, would have provided a regular source of animal protein and grease, while occasional male boar hunts would have been an activity oriented rather towards the acquisition of valued items.

If this study focused on the analysis of teeth remains, we were also able to register in details a large sample of more than the two-thirds of wild boar post-cranial remains from Les Cabônes layer 3 (NISP = 844, MNE = 680, MNI = 16). This sample was tested in order to get some preliminary information regarding carcass processing. These preliminary data suggest that wild boar may have been brought onto the site on a regular basis (cf. formation process of layer 3) as complete or nearly complete carcasses to be butchered (as indicated by the high number of cutmarks) and probably consumed onsite. Wild boar may have been brought onto the site on a regular basis (cf. formation process of layer 3) as complete or nearly complete carcasses to be butchered (as indicated by the high number of cutmarks) and probably consumed onsite. The site occupation corresponding to layer 3 could have lasted more than one season and functioned as a base camp (Cupillard, 2002; Cupillard and Perrenoud-Cupillard, 2003).

The relationship between site function and/or duration of occupation and wild boar strategies has been discussed in other Mesolithic...

### Table 5
Corrected distribution of wild boar teeth in age groups from “Les Cabônes” rockshelter, according to age group size.

<table>
<thead>
<tr>
<th>Age groups</th>
<th>N teeth</th>
<th>MNI</th>
<th>% N teeth</th>
<th>% MNI</th>
<th>Corrected age (in years)</th>
<th>Corrected N teeth</th>
<th>Corrected MNI</th>
<th>Corrected N teeth %</th>
<th>Corrected MNI %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 months</td>
<td>127</td>
<td>11</td>
<td>18.0</td>
<td>22</td>
<td>0–6.5</td>
<td>127</td>
<td>11</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>6–12 months</td>
<td>164</td>
<td>12</td>
<td>23.3</td>
<td>24</td>
<td>0.5–1</td>
<td>164</td>
<td>12</td>
<td>23.3</td>
<td>24</td>
</tr>
<tr>
<td>12–18 months</td>
<td>112</td>
<td>6</td>
<td>15.9</td>
<td>12</td>
<td>1–1.5</td>
<td>112</td>
<td>6</td>
<td>15.9</td>
<td>12</td>
</tr>
<tr>
<td>18–24 months</td>
<td>54</td>
<td>3</td>
<td>7.7</td>
<td>6</td>
<td>1.5–2</td>
<td>54</td>
<td>3</td>
<td>7.7</td>
<td>6</td>
</tr>
<tr>
<td>24–36 months</td>
<td>54</td>
<td>3</td>
<td>7.7</td>
<td>6</td>
<td>2–2.5</td>
<td>54</td>
<td>3</td>
<td>7.7</td>
<td>6</td>
</tr>
<tr>
<td>3–5 years</td>
<td>92</td>
<td>9</td>
<td>13.0</td>
<td>18</td>
<td>2.5–3</td>
<td>92</td>
<td>9</td>
<td>13.0</td>
<td>18</td>
</tr>
<tr>
<td>5–7 years</td>
<td>83</td>
<td>4</td>
<td>11.8</td>
<td>8</td>
<td>3–3.5</td>
<td>83</td>
<td>4</td>
<td>11.8</td>
<td>8</td>
</tr>
<tr>
<td>7–10 years</td>
<td>19</td>
<td>2</td>
<td>2.7</td>
<td>4</td>
<td>3.5–4</td>
<td>19</td>
<td>2</td>
<td>2.7</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>705</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td></td>
<td>705</td>
<td>50</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
contextually, notably from Scandinavian sites. A recent examination of the Mullerup (Denmark) assemblage, interpreted as a base camp attributed to the Maglemose culture, also revealed such hunting strategies targeting sounders and mostly juveniles similar to those observed at Les Cabônes (Leduc, 2010, 2013). Strategies targeting mostly juveniles, “a prey selection that ensures a maximal long-term harvest and can be associated with larger base camp,” are also described at Ringsjóholmen and Tågerup in Sweden (Magnell, 2006b: 95). In contrast, at sites also interpreted as hunting camps, Ageröd I:HC and Bredasten (Sweden), prey selection was made within sounders, avoiding very young individuals in order to “optimize the short-term return rates” (Magnell, 2005, 2006b: 94).

The same may be valid in geographically closer contexts, such as open-air sites from the Paris and Oise area dated to the same chronological period (Leduc et al., 2013; Ducrocq et al., 2008, 2014) with small faunal assemblages (ca 100 identified remains) dominated by wild boar. At these sites, hunters preyed on groups of females with subadults. The absence of very young individuals could reflect similar strategies to those observed at Ageröd I:HC and Bredasten (Magnell, 2005, 2006b), but, in these cases, taphonomic loss cannot be excluded, as the preservation of faunal remains is low (Leduc et al., 2013; Ducrocq et al., 2008, 2014).

Adult males were also killed, most likely during distinct hunting episodes and the use of tusks as tools is documented. However, occupation patterns at these sites are still in debate. At Paris—rue Henry-Farman, it has been concluded that each locus may have for the most part resulted from successive and probably short term (seasonal) occupations, each locus an independent event. The evidence of incomplete carcasses and incomplete butchering “chaînes opératoires” in these sites argues in favor of this interpretation. From this point of view, wild boar exploitation patterns at Les Cabônes, in situ exploitation of complete carcasses, might refer to longer occupations. The site might have functioned as a base camp (Cupillard, 2002; Cupillard and Perrenoud-Cupillard, 2003; Crotti and Cupillard, 2013) as also suggested by the abundance and diversity of archaeological remains, i.e. microliths, lithic tools, bone tools, personal ornaments (e.g. red deer canines), and complete lithic chaînes opératoires. While such a connection exists between site function, occupation cycle and wild boar hunting and exploitation strategies would appear to be a promising avenue of research, such a hypothesis should be qualified, mostly considering the representativeness of faunal assemblages due to taphonomic discrepancies and cumulative or eroded occupations.

Acknowledgments

Financial support for the excavation of the Les Cabônes rockshelter (1978 to 1989) and for AMS radiocarbon dates (2005 to 2008) was provided by the French Ministère de la Culture et de la Communication (Sous Direction de l’Archéologie) under different research programs. We are very grateful to the Mayor of Ranchot for having given us permission to carry out the archaeological excavation of the Les Cabônes rockshelter, Rebecca Miller for English corrections to the manuscript and Nicolas Carquigny for his help in redrawing Fig. 4. We are grateful to the anonymous reviewers for their helpful comments.

References


Fig. 10. Seasonality data from young wild boars at “Les Cabônes” rockshelter, according to different birth period hypotheses.

Fig. 11. Wild boar tusks showing scraping marks on their occlusal surfaces. © C. Leduc.