



HAL
open science

Zooarchaeology, medieval economy and culinary practices: The case of Petra Castellana castrum (South of France)

Dianne Unsain, Vincent Buccio, Pierre Magniez

► To cite this version:

Dianne Unsain, Vincent Buccio, Pierre Magniez. Zooarchaeology, medieval economy and culinary practices: The case of Petra Castellana castrum (South of France). *Journal of Archaeological Science: Reports*, 2020, 30, pp.102170. 10.1016/j.jasrep.2019.102170 . halshs-02481296

HAL Id: halshs-02481296

<https://shs.hal.science/halshs-02481296>

Submitted on 7 Mar 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

Zooarchaeology, Medieval Economy and Culinary Practices: the Case of Petra Castellana *Castrum* (South of France)

Dianne Unsain: corresponding author

Aix Marseille University, CNRS, Laboratoire d'Archéologie Médiévale et Moderne en Méditerranée (LA3M -UMR 7298), 5, rue du Château de l'Horloge, BP 647 F-13094 Aix-en-Provence cedex 2, France. dianneunsain@gmail.com

Vincent Buccio:

Service départemental d'archéologie des Alpes de Haute-Provence, Associate Researcher at Ciham-UMR 5648, France. Vincent.BUCCIO@le04.fr

Pierre Magniez:

Aix Marseille University, CNRS, Ministry of Culture, Laboratoire Méditerranéen de Préhistoire Europe Afrique (LAMPEA -UMR 7269), Aix-en-Provence, France. pierre.MAGNIEZ@univ-amu.fr

Declarations of interest: none

Abstract:

Through the work of historians and zooarchaeologists, French medieval butchery, its regulations, skills, prices and products offered for sale are well known, especially from the 13th and 14th centuries. Nevertheless, the consumer of the high Middle Ages as well as his culinary practices are relatively unknown. This zooarchaeological study of Petra Castellana castrum (11th - 12th centuries AD), in particular bone density and animal utility indices, has shed light on the supply systems and culinary practices of an area of the site. The contribution of textual sources has also been decisive in contextualizing and interpreting the results. This paper puts forward the preparation of two different types of meat cuts: (1) a preliminary cut favouring equally sized pieces of meat, followed by (2) a cooking cut which, on the contrary, was adapted to the different kinds of meat.

Keywords:

Archaeozoology - Middle Ages - taphonomy - animal economy – butchery

37 INTRODUCTION

38

39 Since the 1970s, medieval urban economy has generated a strong interest among
40 European historians, particularly in issues related to animal products/by-products and
41 culinary practices. Consequently, many studies have emerged (e.g., Montanari, 1988; 1993;
42 Flandrin *et al.*, 1999; Adamson, 2004; Woolgar, 2006; Lewicka, 2011; Gautier, 2013;
43 Montanari, 2015). The south of France has benefitted from this trend with, for example, the
44 work of Sclafert (1959), Stoff (1970), Ferrières (2002), Horard and Laurieux (2017) or
45 Petrowiste and Lafuente Gómez (2018). Subsequently, advances in medieval
46 zooarchaeology through international studies such as those of Baker (1993), Bartosiewicz
47 (1995), Albarella (2005) or Grau-Sologestoa (2015) have nuanced or completed the
48 information provided by textual sources. Substantial research in southern France such as
49 that of Forest (1987), Leguilloux (1994), Catalo *et al.* (1995), Durand *et al.* (1997), Rodet-
50 Belarbi and Forest (2008) and Bertin *et al.* (2017) has largely been inspired by the work of
51 Audoin-Rouzeau (1986) although hers was not about the south of France. In this context,
52 urban supply issues, changes in food choices and regional culinary practices have been at
53 the very core of discussions. These considerations have highlighted two main points. First,
54 the incredible complexity and diversity of these phenomena, making it extremely difficult (if
55 not impossible) to propose a recurrent pattern between periods, regions or settlement types.
56 Secondly, issues and biases in archaeology and history are different. For example,
57 zooarchaeology is able to fill in the gaps in textual sources for periods preceding the 13th-14th
58 centuries AD and to verify and complete the available data. Nevertheless, it can hardly
59 address some topics such as trade, regulations and cooking. It will necessarily have to rely
60 on posterior texts (or iconography) to contextualize its results, thus exposing itself to
61 anachronisms. These obstacles are inherent. Yet, bringing these two disciplines together is
62 crucial to the study of medieval societies.

63 In this way, Provençal butchery, its rules and skills as well as its prices and the products
64 offered for sale, are well known. Nevertheless, whether from textual or material sources,
65 consumer-specific information is very often supplanted by that of the butcher: archives
66 overwhelmingly collect legislative texts aimed at regulating and standardising meat selling or
67 refer to complaints which bear witness to the tensions between butchers and local authorities
68 (Stoff, 1970; Ferrières, 2002; Petrowiste, 2018). In addition, the methods applied by
69 zooarchaeologists may be biased because it is difficult to determine whether the meat diet
70 was marked by a production/consumption dynamic or only consumption. This issue is even
71 more crucial when the context is not clearly identified as urban. Thus, several questions
72 arise: was the site supplied by a butcher or through private production? If from a butcher,
73 was it a travelling butcher who slaughtered and butchered the animals? A major underlying

74 question lies behind these issues: were carcasses consumed entirely by a single household
75 or were they shared among the inhabitants of the settlement? Without these data, how can
76 we meaningfully discuss the various contributions of different social groups to meat
77 consumption? Another question remains concerning meat: how to distinguish traces left by
78 the butcher from those produced by the consumer during preparation and consumption?
79 While zooarchaeology studies are interested in eating practices, they are most often based
80 on slaughter ages and butcher marks (e.g., Audoin-Rouzeau, 1986). Nevertheless, this
81 approach is incomplete, especially since the author of these traces remains, as previously
82 mentioned, unidentifiable.

83 The zooarchaeological study of Petra Castellana (11th - 12th centuries AD) is based on these
84 considerations and on the historical and archaeological studies mentioned above. There is
85 another particularly interesting point: no written source defines the status of Petra Castellana.
86 The agglomeration below (Castellane) is known as a city, but only later, during the 13th and
87 14th centuries AD. The mention of *castrum* and *castellum* only reveals that Petra was a
88 fortified agglomeration. So, was it a city or merely a town? Given that its church was
89 parochial until the middle of the 13th century AD and considering the size of the site, it is
90 highly plausible it was a city. It seems that during the main settlement of the *castrum*, Petra
91 was the political (vicinity of the castle), military (the fortifications) and religious (the parish)
92 centre of both agglomerations. However, there is no way of telling which, the *castrum* or the
93 lowland, held the economic core. The unclear status of the site, combined with the results of
94 the zooarchaeological study, led to the questions presented above. This paper discusses,
95 through different sources and methods, the status of Petra Castellana and its economic
96 bonds with the lowland habitat. Taphonomy has also been a decisive tool in apprehending
97 the consumer as well as the medieval cuisine.

98

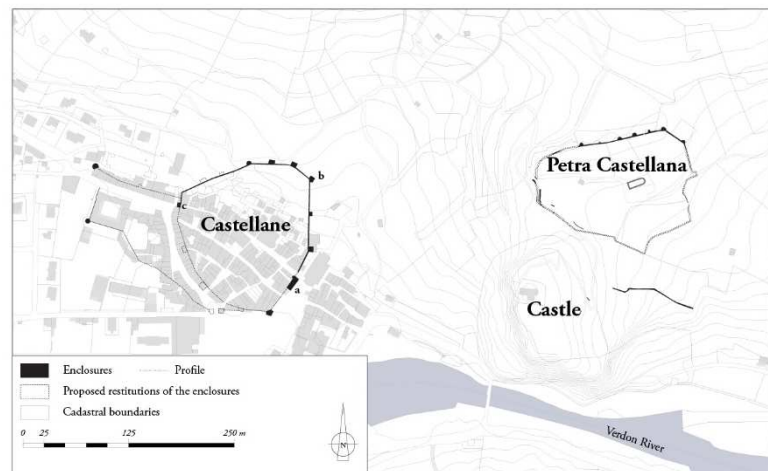
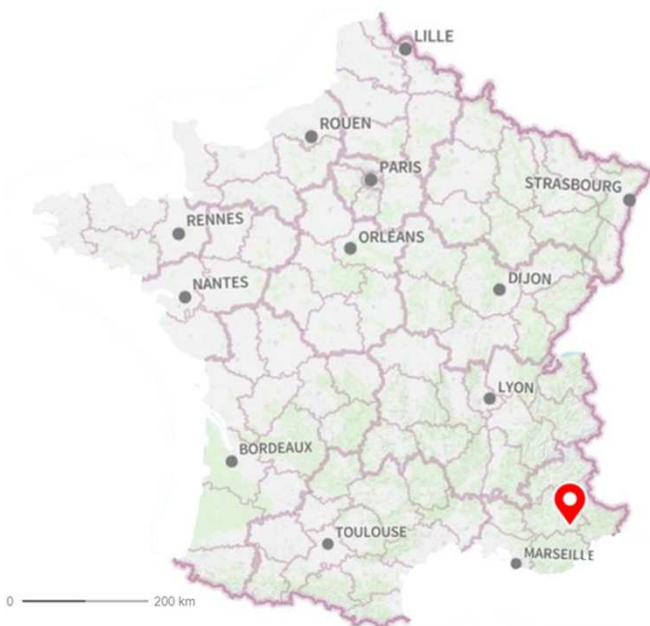
99 1. MATERIALS AND METHODS

100 1.1. The site

101 Located in the Verdon Valley, Castellane (Alpes de Haute-Provence, Fig. 1) corresponds
102 to the location of the capital of a Gallic population ("*Suetrii*") and to a chief town in Roman
103 times: *Salinae*. These two agglomerations are poorly known. In the 11th century AD, a
104 fortified settlement (Petra Castellana) and a castle (where the Castellane family lived) were
105 built on the heights of the current town. Shortly afterwards, still during the 11th century AD,
106 the town of Castellane emerged in the lowlands. In 1262, following a siege of the castle and
107 *castrum*, the Counts of Provence drove out the Castellane family, and the latter's
108 possessions entered the Counts' domains. The *castrum* started to be abandoned quite early,
109 between the 13th and 14th centuries AD in favour of the city below. The beginning of this
110 desertion is potentially linked to the siege and to the resulting destructions. In the Middle

111 Ages, Castellane was an important regional centre. The Lords of Castellane were, from the
 112 10th to the 13th centuries AD, among the most important and powerful families in Provence.
 113 Castellane was also an important economic centre in the Alpine area. Located at the
 114 convergence of several axes leading into the Alps, it dominated one of the few convenient
 115 crossing points of the Verdon river. The presence of gypsum in local geological formations
 116 leads to the rising of salt springs. These were exploited in ancient times and explain the
 117 name of the city during Roman times. This salt, combined with the roads, made Castellane
 118 an important point for transhumance. The relatively opulent medieval Castellane was
 119 represented by three main sites (fig 2): (1) the Roc, on which the fortress was erected until its
 120 destruction at the end of the 15th century, (2) Castellane, where the current town is located,

121 mentioned in the 11th century and fortified in
 the middle of the 14th century AD, and (3)
 Petra Castellana, the focus area of this study.
 The *castrum* dominated the Verdon valley by
 its position and the city was easily accessible
 to its inhabitants (at about 300 metres).



128
 129
 130
 131 This settlement of about two ha (fig. 3)
 132 has been the target of planned excavation
 133 campaigns since 2016 (Buccio *et al.*, 2018). It has a still partially standing enclosure and a
 134 parish church (adjacent to zone 12). Several surveys across the site have aimed at studying
 135 both buildings and open spaces. These surveys represent about 2% of the surface area of
 136 the settlement.

137 At the end of three excavation campaigns, the first documented medieval occupation was
 138 attributed to the 11th and 12th centuries AD. Most of the faunal material is associated with this

Figure 1 : geographical location of Castellane (map from geoportail.gouv.fr) (B&W)

Figure 2: Petra Castellana, the castle and Castellane (B&W)

139 settlement. Two later settlements left few remains and stratigraphic disruptions have led to
 140 their exclusion from analysis. The site was on agricultural land, including terracing, until the
 141 1950s. The excavation revealed residential buildings that originally probably had a residential



Figure 3 : Plan of Petra Castellana and location of the excavation areas (Buccio) (colour)

142 level, but from which little material was recovered (zone 8). Built manufacturing and trade
 143 areas have also been identified. South of the site, but still within the urban zone, there is a
 144 silo area (zone 5).

145
 146 During the archaeological intervention, 2,440 faunal remains (identified and non-identified
 147 = NR) were found. Nearly 63% of these finds dated from the 11th and 12th centuries AD
 148 (1,529 faunal remains). For this occupation, the NISP (Number of Identified Specimens) was
 149 793 (53%). The remains, kitchen waste, were essentially concentrated in the occupation
 150 levels (NR = 828 or 54%) and the pit fills (NR = 106 or 7%). Most of the assemblage
 151 therefore comes from well-defined archaeological contexts. The fills (diverse) were also rich
 152 in remains, with NR = 435 (or 28%).

153
 154 1.1. Method

155 1.1.1. General data

156 The faunal material was collected by hand, on sight. A multifactorial zooarchaeological
157 study was conducted. It included the identification of the remains at the anatomical and
158 taxonomic level, basic quantifications according to Lyman (1994), the study of animal
159 resources management, butchering analysis and a taphonomic study. To distinguish
160 between goat and sheep, (*e.g.*, Helmer, 2000; Fernandez, 2001; Zeder and Lapham, 2010)
161 the lower cheek teeth and long bones were used. The age at death was estimated from the
162 degree of bone fusion (*e.g.*, Barone, 1976; Zeder, 2009; Zeder *et al.*, 2015) as well as from
163 dental eruption and tooth wear. For *Suidae* and sheep/goat these estimates were made from
164 observations of the eruption sequence and the degree wear of the upper and lower cheek
165 teeth. The rankings are based on the tables of Matschke (1967) and Bridault *et al.* (2000) for
166 pigs, on those of Greenfield and Arnold (2008) for sheep/goat and on Jones and Sadler
167 (2012) for cattle. The composition of the assemblages is described through the Number of
168 Remains (NR), the NISP, the Minimum Number of Individuals by frequency and by
169 comparison (MNI_f, MNI_c, for further discussion about MNI biases see, *e.g.*, Plug and Plug,
170 1990; O'Connor, 2001), the Minimum Number of Elements (MNE) and the standardised
171 Minimum Animal Unit, expressed in %MAU (Binford, 1978; Brugal *et al.*, 1994; Lyman,
172 1994). It should be noted that laterality and rank (ribs; vertebrae) are not included in graphic
173 anatomical representations. The same goes for phalanges (anterior, posterior, medial,
174 lateral). Finally, bone survivorship, expressed in %MAU, was applied on the whole bone for
175 the skull, vertebrae and girdles. This explains the difference between the levels of
176 survivorship of these anatomical elements and that of the long bones. Long bone
177 survivorship was documented by dividing each bone into five sections: proximal and distal
178 joints and then proximal, median and distal diaphyses. This type of representation enables
179 the clear visualisation of anomalies. All identified specimens were examined for
180 anthropogenic bone-surface modifications (bone fracturing, *e.g.*, Villa and Mahieu, 1994, and
181 cutmarks, *e.g.*, Audoin-Rouzeau, 1986, Lyman 1994b). Number of marks, anatomical
182 position and orientation were systematically recorded.

183

184 2.2.2 Specialised study: animal density and utility indices

185 Although the lack of data for some bones may bias the results, density and utility
186 indices remain important because they can help explain the under- or over-representation of
187 some elements. Therefore, skeletal bone density indices for sheep/goat, *Suidae* and cattle
188 (Kreutzer, 1992; Ioannidou, 2003) were compared with %MAU through a correlation test
189 (Spearman's *rho*). The aim was to determine whether there was a correlation between the
190 mineral density of the anatomical parts and their level of representation in the assemblage.
191 Table 1 (Appendix) presents the codes used, the density indices and %MAU for the three

192 taxa. Through this method material preservation can be evaluated and differences between
193 the bone sample studied and an expected theoretical assemblage can be compared.

194

195 In order to assess hunter-gatherer survival strategies during the Pleistocene, Binford (1978),
196 followed by other specialists (Jones, Metcalfe, 1988; Lyman, 1994; Brink, 1997; Rowley-
197 Conwy *et al.*, 2002), developed animal utility indices based on meat (muscle and adipose
198 tissues), bone-fat and marrow content in the different anatomical parts, according to the
199 species. The objective of this method was to identify the preferred use of one and/or the
200 other of these resources and to deduce, for instance, an intensive exploitation which could
201 be attributed to a scarcity of food. This type of study has not been carried out on more recent
202 contexts.

203 In the current study, the standardized Food Utility Index (sFUI) was used. It combines the
204 different consumable portions mentioned above (Lyman, 1994). This analyse was conducted
205 following the same protocol explained above for the density indices. The density and utility
206 indices for cattle are those established for bison. The same goes for the utility indices of pigs
207 (made for wild boar) and for sheep/goat (made for sheep). These data may, however, be
208 used for taxonomically related species (e.g Rowley-Conwy *et al.*, 2002). The aim was to
209 evaluate whether adapting this method to recent contexts could be an effective means to
210 address meat consumption strategies. Since the utility indices of the median diaphyses were
211 not available, the lowest value from the proximal and distal diaphyses of the same bone was
212 systematically assigned to it.

213

214 2. RESULTS

215 2.1. Taxonomic distribution and herd composition

TAXA	NISP
Avifauna	2
<i>Bos taurus</i>	188
Bovids	2
<i>Canis lupus fam.</i>	1
<i>Capreolus capreolus</i>	2
Sheep/goat	754
<i>Cervus elaphus</i>	1
<i>Equus sp.</i>	30

216 A total of 11 taxa were identified. The best represented are
 217 sheep/goat (*Ovis aries* and *Capra hircus*) with 497
 218 determined remains or 62% of the NISP. *Suidae* and cattle
 219 are observed in similar proportions (156 and 128 elements)
 220 while the other taxa (*Equus*, *Canis lupus*, *Cervus elaphus*, *Capreolus capreolus*, *Ursus*
 221 *arctos*, avifauna and lagomorphs) are poorly represented (Table 1).

Lagomorpha	2
<i>Sus scrofa</i>	249
<i>Ursus arctos</i>	1
TOTAL	1232

222
 223
 224 The MNIC for cattle is four. Age-at-death estimates indicate the presence of two juveniles and
 225 two adults. Pigs are slightly better represented (MNIC = six). Canine morphology suggests
 226 the presence of at least one male and one female. No wild boar was identified (based on the
 227 absence of reliable criteria of subspecies distinction in the assemblage), nor were individuals
 228 within the very young or the older adult categories identified. Five pigs were slaughtered at
 229 the optimum fat and meat yield age (one to two years old; Horard-Herbin, 1997) and another
 230 at a later stage (between four and eight years old).

231
 232 For sheep/goat, the MNIC is 22. Twenty-five percent (25%) of *Table 1: taxonomic repartition, NISP*
 233 these animals were between three and 15 months old (Fig. 4).
 234 Adults (three to eight years old) were the most numerous, representing nearly 70% of
 235 individuals. There is a peak around four-year olds and a more pronounced one for five- to
 236 eight-year olds. A ratio of 14 sheep to one goat was estimated through the observation of
 237 morphological criteria.

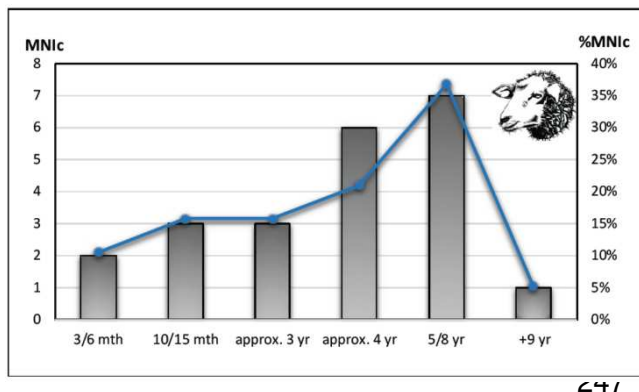
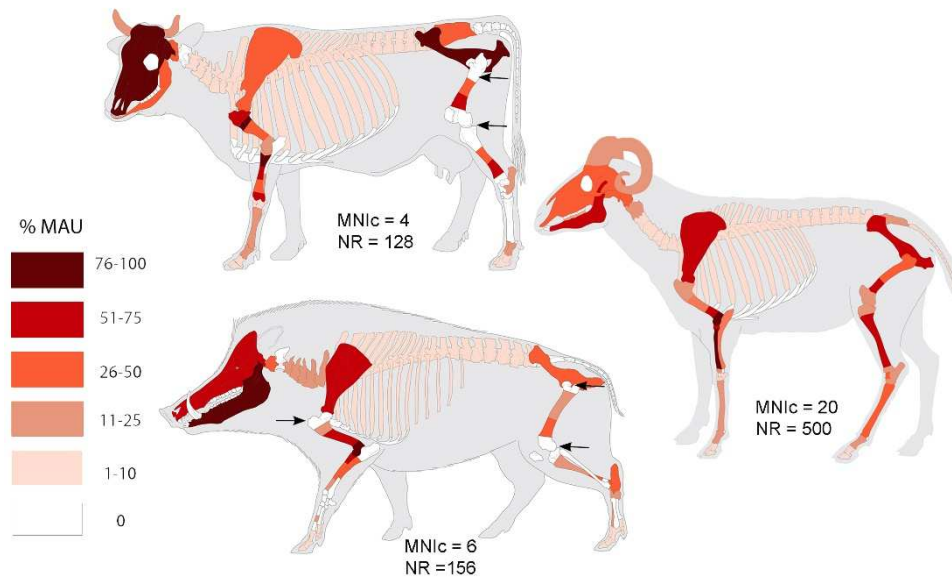


Figure 4: Slaughtering ages for sheep/goat expressed in MNIC (the curve stands for the %MNIC) (B&W)

248
 249
 250 1.2. Skeletal representation
 251

252 Figure 5 quantifies the frequency of anatomical elements for cattle, pigs and sheep/goat.
 253 These frequencies will not be discussed in detail, but several observations need to be
 254 highlighted. There is a discrepancy between the frequencies of forelimbs and hindlimbs of
 255 cattle. The NISP is close for both (33:25). Yet, the forelimb is observed in full whereas there
 256 is a selection of hindlimb elements: femoral and tibial diaphyses (median and distal parts).



257 Furthermore, coxal elements are overrepresented compared to the ends of the hindlimb long
 258 bones, which are completely absent, as is a considerable portion of the tarsals and
 259 metatarsals. These data are particularly surprising since the MNE for the coxal bone was
 260 obtained from the acetabulum. It is remarkable to observe such a contrast around anatomical
 261 connections: well represented vs completely absent portions. Even more striking is that this
 262 same pattern can also be observed for the forelimbs and hindlimbs of pigs (except for the
 263 humero-radial joint). For sheep/goat, however, there is no obvious under-representation of

Fig. 5: Skeletal representation of cattle, pigs and sheep/goat (%MAU). Arrows point to abnormal underrepresentations. Font from ArcheoZoo.org / Michel Coutureau (Inrap), Vianney Forest (Inrap) 1996 (Colour)

264 any particular element or portion of an element.

265

266 1.3. Density and utility indices

267

268 1.3.1. Density indices

269 For cattle (fig. 6), Spearman's ρ shows no correlation between the %MAU and the mineral
 270 density ($R_s=0.04$; $p=0.77$). For suids ($R_s=0.27$; $p=0.07$) and for sheep/goat ($R_s=0.30$; $p=0.05$),
 271 the correlation is low. For cattle, the denser bones do not seem to be better preserved than
 272 the low-density elements. The distal part of the cattle femur (F6), with low density, is absent,

273 while the proximal humerus (H1), with a similar density, is strongly represented. For
 274 sheep/goat and pigs, however, the results suggest that density plays a stronger role in
 275 sample composition. For sheep/goat, the cervical (CE1) and thoracic (TH1) vertebrae are
 276 poorly represented and have low density. However, this does not reflect natural preservation
 277 as some elements are abnormally represented. This is the case for the median diaphysis of
 278 the metacarpus (MC2) or the distal diaphysis of the radius (R4). The relatively dense distal
 279 metacarpus is under-represented while the less dense radius diaphysis is over-represented.
 280

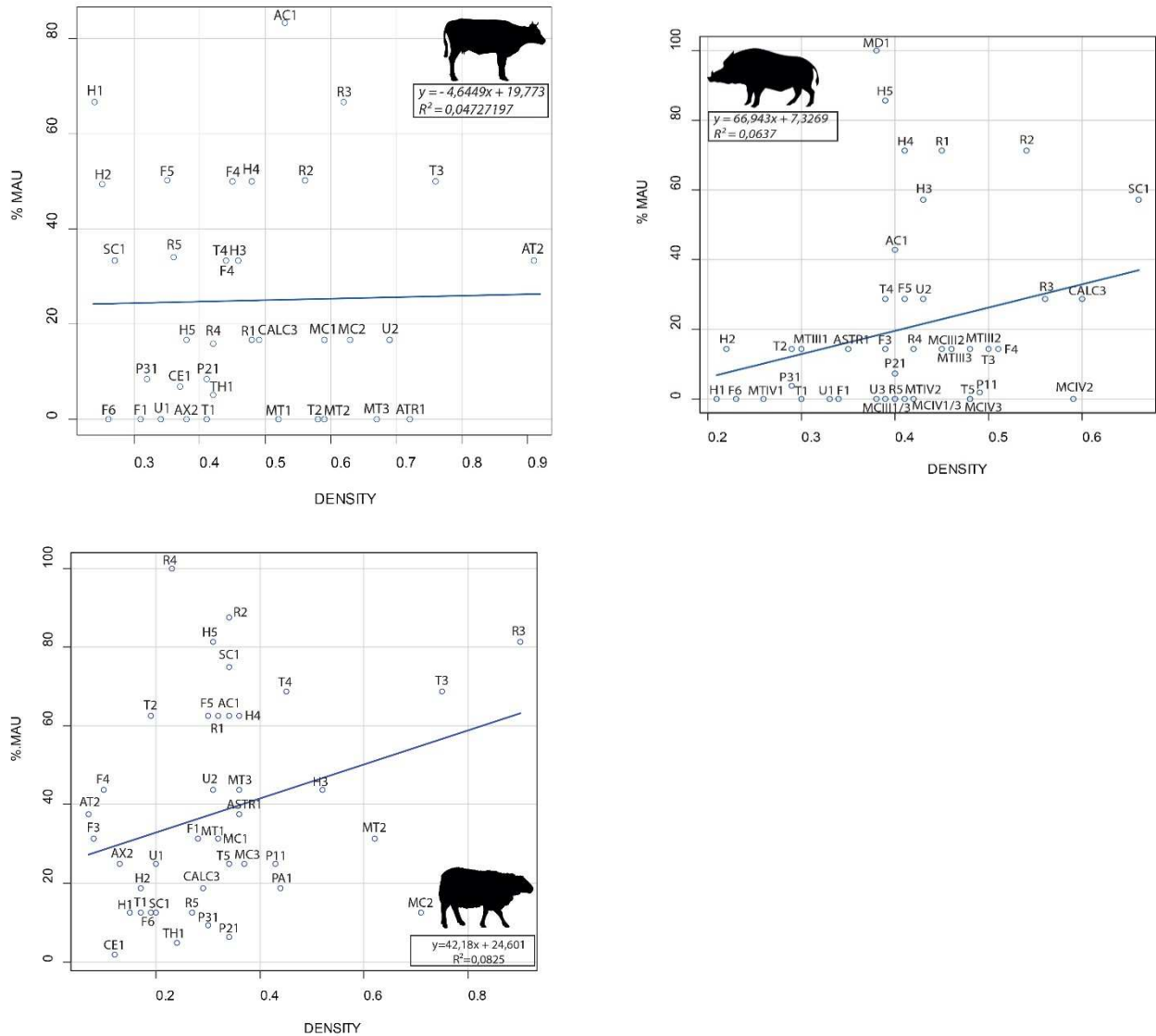


Figure 6: Comparison of cattle, pigs and sheep/goat skeletal parts (%MAU) and mineral density indices. See appendix for codes used (B&W)

282

283 1.3.2. Utility indices

284 Spearman's ρ does not show any correlation (Fig. 7) for cattle ($R_s = -0.04$; $p = 0.77$) and
 285 sheep/goat ($R_s = 0.080$; $p = 0.61$). This suggests that the %MAU of anatomical portions is not
 286 correlated to their nutritional content. For example, the thorax, one of the most nutritious

287 parts of the body of these three taxa, is almost absent. This does not mean, however, that
 288 the thorax was not consumed, a point which will be addressed later. It is important to note
 289 that some elements with very low meat or fat content are scarcely observed, such as the
 290 ends of legs. It should also be noted that several portions with very similar utility indices are
 291 observed in various proportions: for cattle, the thorax and the femur are the most nutritious
 292 elements (70 to 100% sFUI) but offer a %MAU going from zero to nearly 50. For sheep/goat,
 293 the utility index is identical for the coxal and for the different parts of the femur (about 80%)
 294 but the %MAU ranges from 15 to more than 60%. Among the best-preserved bone portions,
 295 density is generally average and therefore does not seem to be decisive. On the other hand,
 296 pigs show a significant correlation ($R_s=0.26$; $p=0.05$). However, the statistical result shows a
 297 relationship between bone representation and nutritional value and must clearly be
 298 considered in the archaeological interpretation, alongside the established utility indices (e.g.,
 299 higher nutritional value of the thorax over the rest of the body). A closer look at the results
 300 shows that there is a wide variety of representations for the same nutritional values.
 301

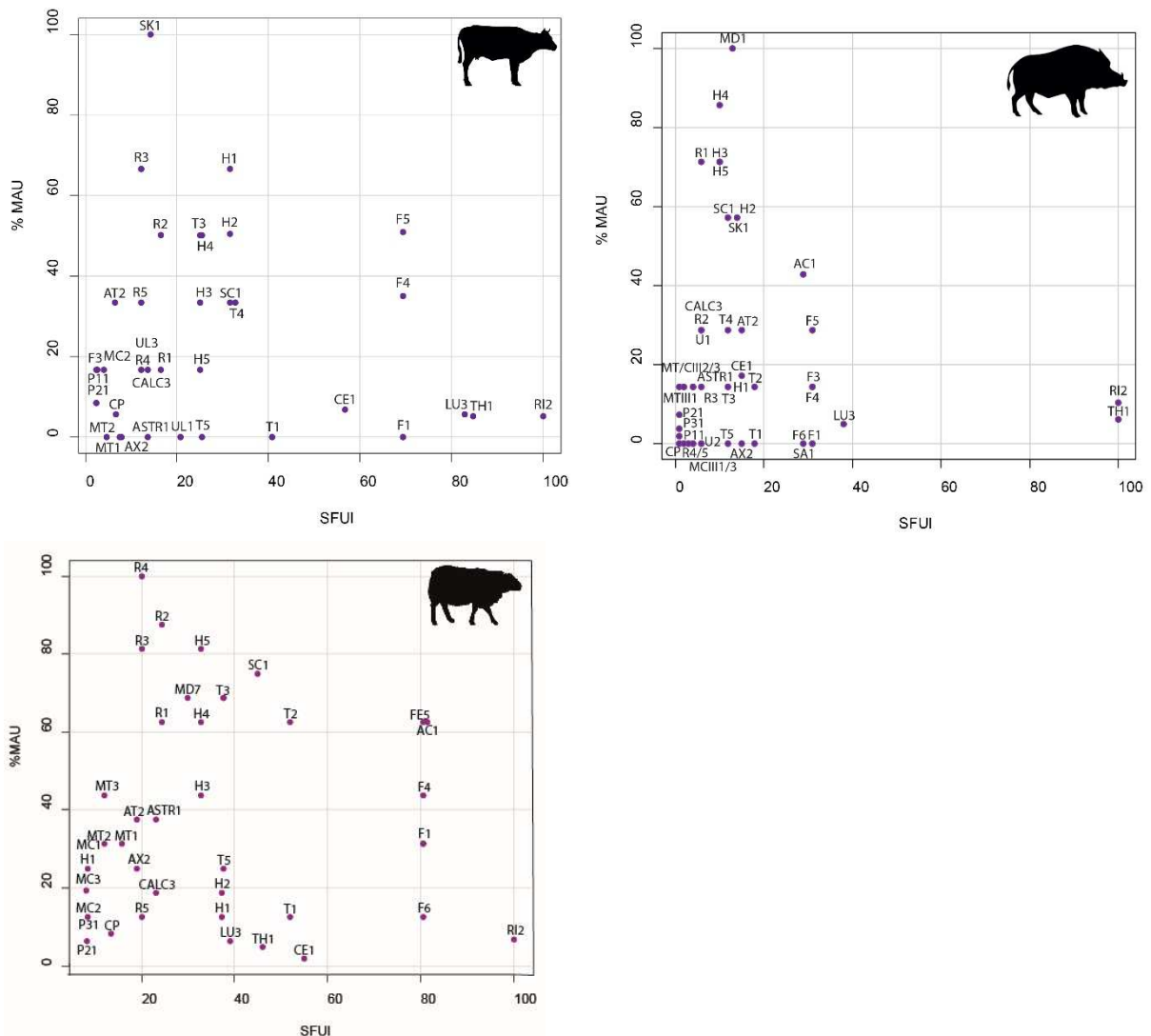


Figure 7: Comparison of cattle, pigs and sheep/goat skeletal parts (%MAU) and standardised Food Utility Indices (sFUI). See appendix for codes used (B&W)

302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338

1.3.3. Butchering analysis

Blade marks found on both cattle and pigs are scarce and could reflect a certain professional level of skill: The more skilled the butcher is, the less marks he leaves on the bones when he picks up the meat (Lignereux, Peters, 1996). For sheep/goat (Fig. 8), marks are more frequent, but this can be explained by the NISP which is five times higher. Fractures on fresh bones are numerous. Nevertheless, few are the same for cattle and pigs. It is therefore difficult to establish a carving model for these species.

For each taxa, the skull was also consumed. For goats and pigs, the skull was separated from the rest of the body at the atlas or occipital condyle, where several sharp or blunt blows were made, probably keeping the head down. The horn-cores of goats were recovered and sliced or torn off, maybe for raw material. Finally, the mandibles were separated by tearing at the synchondrosis and cutting them into irregular portions.

The thoracic elements are generally scarce. It seems that three sections were usually extracted from the ribs. The numerous incisions on the ventral surface of the ribs indicate that they were cut at the abdomen. The breaking line was marked with a blade and pressure was applied to break the rib. Sharp blows were rare. Cattle thoracic and lumbar vertebrae were cut longitudinally at each of the transverse apophyses. In small bovids, the cervical vertebrae were cut longitudinally at their centre. Thoracic and lumbar vertebrae were either cut at the centre or at each apophysis, a double incision (*double fente*, Audoin-Rouzeau, 1986, p. 115). For pig, limited data are available. It seems that the simple incision was preferred.

The legs were mainly sectioned by percussion, whatever the species. The cut is also very similar between taxa. As a result, impact marks were found on the entire skeleton, except for the ends of the legs, which were almost absent. For sheep/goat, as they are better represented, fractures have been observed on the metapods. For each species, all long bones were heavily fractured, releasing small portions, with an average of three to four parts per bone.

339
340
341
342
343
344

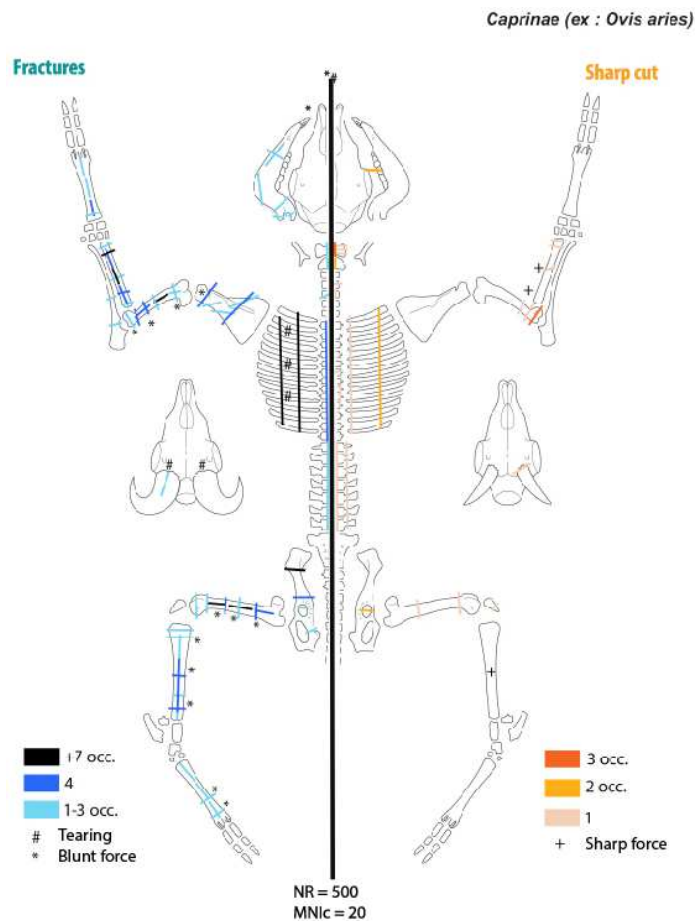


Fig. 8: Location of anthropic traces on sheep/goat. Font from Archeozoo.org/ Michel Coutureau (INRAP 2013)) (Colour)

345

346

347 2. Discussion

348 2.1. Meat quality and demography

349 Cattle age-at-death is diverse and there is a lack of mature adults, but the low MNI makes
350 interpreting the management of the cattle herd difficult.

351

352 Pigs were generally raised for meat and fat but also for skin (as well as cattle and
353 sheep/goat). Castellane is known for its hides, whose techniques are inherited from Grasse,

354 with which it has close economic links since the 11th century AD (Sclafert, 1959). The locality
355 had its own tawery. Petra Castellana's animal products were therefore not limited to food but
356 were a major economic factor. Most of the meat was of average quality (adult sheep) but a
357 few good products were also consumed (three lambs).

358

359 The prevalence of sheep/goat over other domestic species is common in Provence
360 (Leguilloux, 1994; Rodet-Belarbi, 2011a; b; c) and more broadly in the Mediterranean region
361 (e. g. García-García, 2017). Caprine mortality profiles correspond mainly to fleece production
362 (40% from six to ten-year olds) more than to meat consumption (Payne, 1973; Horard-
363 Herbin, 1997). The latter is focused on individuals younger than three years olds, whereas
364 75% of Petra's sheep/goat remains exceed that age-at-death. The age-at-death profile
365 suggests, rather, wool production on the site or in the vicinity: owners selling non-productive
366 animals downtown to the butcher (Forest, 1998). Furthermore, the Provençal butcher could
367 travel long distances to obtain supplies of animals at fairs or from animal farming areas
368 (Stouff, 1970¹). This practice, however, was hazardous according to Stouff (1970) because
369 once on site, the quantity and/or quality required may not have been available. For him,
370 "*l'élevage est inséparable de la boucherie pour tous les macelliers*" (Stouff,
371 1970, p. 153-154). In other words, breeding and butchery are inseparable for all butchers.
372 Therefore, butchers actively participate in the pastoral economy: they use various breeding
373 contracts known for the Toulouse region and Provence (Wolff, 1953 ; Sclafert, 1959). This
374 multiplicity of butcher activities must be linked to their status. In the city, the wealthiest ones
375 combined activities and delegated their work. They were breeders and could sell skins,
376 tallows, live animals, meat, fish and wool (Stouff, 1970).

377

378 2.2. Meat processing and culinary practices

379 2.2.1. Cooking

380 The systemic absence of some cattle and pig long-bone ends could be explained by a
381 spatial distribution of meat but this hypothesis is hardly conceivable because it is too
382 systematic, and the portions are too precise. The absence of these long-bone ends is more
383 likely linked to a differential treatment of these parts. Consumers were able to put these
384 pieces aside (in a fairly systematic way) for later consumption, in a bone soup for example
385 (Binford, 1978). Prolonged cooking, which allows fat to diffuse into the preparation, weakens
386 the bone and can lead to its destruction (Costamagno, Rigaud, 2013).

¹ His work is relevant because, even if it focuses mainly on the 14th century AD, the meat preferences described are very close to zooarchaeological data from earlier periods.

387 This feature has been observed at the charitable institution of the Pas hospital in Rodez in
388 the 14th century AD (Catalo *et al.*, 1995). Here, however, the cuts were larger than in Petra,
389 with four or five pieces per limb compared to usually six or seven in Petra. The chronological
390 shift between the two collections could explain this difference. Indeed, important
391 morphological changes affected culinary ceramics from the 13th century AD onwards. Small
392 globular pots (the opening diameter of those of Castellane is between nine and 15 cm, or
393 between 3.5 and 5.9 inches) were largely substituted by cooking pots and large open shapes
394 (Lécuyer, 1997). This shift may have favoured larger pieces of meat in later settlements.
395 Notwithstanding, the different distribution of food seems to be the main factor. In Petra
396 Castellana, the waste comes from family units, while in Rodez, it is from a collective kitchen.
397 The culinary equipment had to be adapted, with larger shapes. Bone broth is not surprising
398 for a hospital setting as it is a highly nutritious and low-cost food for patients, in this case,
399 women in childbirth, pilgrims and the poor. For Petra, results suggest a variety of culinary
400 practices depending on the anatomical area and the species.

401
402 Finally, the MNE of the three taxa varies for each anatomical part, suggesting that a whole
403 animal did not necessarily go to the same person. In rural environments, a "self-sufficient"
404 supply is to be expected, with complete treatment of the animal, whether through fresh meat,
405 cured meats or charcuteries. This practice allows consumers to have meat over a long
406 period. For Petra Castellana, it corroborates the purchase of meat and therefore the
407 proximity of an urban community (in situ or in the lowland).

408

409 2.2.2. Density indices

410 The different results for sheep/goat can be explained by a much higher number of
411 remains or by a distinct anthropic contribution and/or treatment to that of cattle and/or pigs.
412 Nevertheless, in all cases the results indicate that density itself does not fully explain the
413 composition of the assemblage and that other factors were involved: human action,
414 carnivores and/or physicochemical agents.

415

416 2.2.3. Utility indices

417 Results suggest three types of meat processing:

418 (1) Some very valuable cuts but among which only a few of the observed parts were
419 intensively exploited, completely destroying them or at least, preventing any taxonomic
420 identification of these elements. The large number of thoracic remains that are taxonomically
421 undetermined support this argument even if taphonomical processes cannot be discarded.
422 Among the 150 rib remains studied, 95 could not be taxonomically identified (nearly 63%).

423 For vertebrae, 43 of the 97 remains could not be identified to taxon (44%). Because of the
424 fragility of these elements, their nutritional value is certainly underestimated.

425 (2) Stylopodia, meaty and better represented than ribs but also than zeugopodia, were
426 probably highly consumed but in such a way that they were not destroyed, suggesting a
427 variety of culinary practices.

428 (3) The weak survivorship of pieces of low nutritional value (mainly autopodia) can be
429 explained by a) a rejection, which appears unlikely since feet are consumed for all three
430 species (Stouff, 1970), b) their consumption and subsequent disposal in an unexplored area
431 of the site, a more probable hypothesis, and/or c) the sale, to the tanners, of autopodia
432 attached to the skin.

433

434 2.3. Meat consumption

435 *"A beginner uses a knife every month. An average butcher uses a knife every year. I've been*
436 *using the same knife for nineteen years. It butchered several thousand cattle, without any*
437 *wear of any kind. Because I only let it pass through where it can pass". Tchouang-Tzeu (370-*
438 *287 BC; in Lignereux, Peters, (1996).*

439

440 This quote perfectly summarises the butcher's skill and explains the paucity of cutmarks. For
441 thoracic elements, the double incision (or spine lift) technique seems to have been used in
442 cattle. It consists in extracting the vertebral nucleus by fracturing on either side of the
443 vertebrae (Audoin, Marinval-Vigne, 1987). This is the case in La Charité-sur-Loire until the
444 14th century AD (Audoin-Rouzeau, 1986). Among small cattle (Fig. 3), several methods seem
445 to coexist: the thoracic and lumbar vertebrae are divided either by a single incision, as at the
446 Hôtel-Dieu de Marseille (Rodet-Belarbi, 2011a), facilitating the extraction of ribs with part of
447 the vertebrae and associated fat, or through a double incision to isolate the core, rich in
448 marrow. There may have been several "butchers" (professional or not) with different
449 techniques. However, it was during the 14th century AD that butchery began to be
450 standardised (Audoin and Marinval-Vigne, 1987). The single incision becomes an absolute
451 rule for sheep/goat. Before this time, the technique for cutting, including this taxon, is variable
452 and results in a greater variety of pieces and therefore in a wider range of culinary
453 preparations.

454

455 The sectioning of long bones into parts of equivalent size is comparable to the findings at the
456 Hôtel du Pas in Rodez and Hôtel-Dieu in Marseille (Catalo *et al.*, 1995; Rodet-Belarbi,
457 2011a). During the medieval period, butchers could set their prices without considering the
458 quality of the meat, but only the animal's species, its age and sex. Thus, the butcher often

459 favoured pieces of equal size, faster and easier to extract and well suited for retail
460 (Petrowiste, 2018). These results raise questions about the place of standardised or
461 "generic" meat cuts (Petrowiste, 2018) in the medieval diet. It also suggests two distinct
462 phases in cutting, similar to those described by Lyman (1994): the butcher's cut resulting in
463 standardised meat cuts, which corresponds to Lyman's "secondary butchery stage", and the
464 consumption cut, linked to different culinary practices (the "final butchery-consumption
465 stage"). To delve further into these questions, it is necessary to apply the method outlined
466 here (or to develop new ones and apply them) to other assemblages in an attempt to
467 distinguish the marks made by the butcher from those left by the consumer.

468

469 2.4. Contributions from textual sources

470 In Antiquity, according to K. Seetah (2002), the price of a cleaver, its size and the skills
471 required to handle it make it the butcher's tool of choice. These statements probably also
472 apply to the Middle Ages. Indeed, these tools, found in medieval iconography, were adapted
473 to effectively fracture even the densest bone. The use of other objects is therefore difficult to
474 contemplate because they need to be robust, heavy and have a suitable blade to optimise
475 the force. However, hatchets and the carpenter axe (a small axe; handle and blade often
476 about 12 inches or 30 cm) are worth mentioning, as they could have been used and were
477 sometimes mentioned (Stouff, 1970). These tools, mainly reserved for loggers, charcoal
478 makers and carpenters (Burri *et al.*, 2013) are close to those found in iconography used to
479 stun and carve cattle and pigs (Monteix, 2007). But if these tools look suitable for cutting ribs,
480 they seem inappropriate for chopping thicker bones such as long ones. Thus, the many
481 severed elements identified (97, including 25 long bones) could indicate a professional's
482 work. Slaughtering would have been carried out by people with appropriate anatomical and
483 technical knowledge, as slaughtering and cutting up an animal is difficult. In this sense, the
484 strategic use of a cleaver (or leaf), mainly at the joints, could also be evidence of a
485 professional's work. The many blunt blow and the low presence of cutmark does not
486 invalidate this hypothesis because the cleaver (like the axe) could be used to strike with
487 either the blade or the back of the tool (Seetah, 2002; Monteix, 2007). In addition, the mallet
488 was part of the butcher's tools (as indicated, for example, in the iconography of *Tacuinum*
489 *Sanitatis*²).

490

491 Although the presence of a butcher is not exceptional, it is essential in order to address the
492 supply systems and economy of the site. On this subject, L. Stouff indicates for Provence

² Ibn Butlan, ca 1440. *Tacuinum Sanitatis*, illuminated manuscript, Germany, BNF, Manuscrit latin 9333, fol. 71 v

493 that the *macelliers*³ were present in all cities and in the "vast majority" of Provençal villages
494 (Stouff, 1970, p.114). He adds they were scarcer in hostile regions, especially when crossing
495 the Verdon valley. Indeed, the harsh climatic conditions meant that thousands of animals
496 went down to the Lower Alps at the beginning of winter. To do so, herdsmen crossed
497 Castellane, which had its own salt springs, considered a great asset for agropastoral
498 activities (Moriceau, 2005). Besides, the locality was key in the regional economy, directly
499 linked to animal products. Textual sources mention the installation of a large fair in
500 Castellane. In the 13th century AD, it is already considered very old, so during the apogee of
501 the site (11th - 12th centuries AD) it must have already been in existence. A large proportion
502 of the skins produced on site (see 2.1.) were sold at this fair (Sclafert, 1959). The locality was
503 therefore a strategic trading place probably visited by neighbouring populations (especially
504 the highland inhabitants of the Haut Verdon). During the winter, the latter could have
505 obtained supplies from Castellane to cope with the lack of meat until the return of the herds
506 and the travelling butchers.

507

508 2.5. The diet of the common and the mighty folk: the case of medieval Provence

509 The results from Petra Castellana can be compared with similar contexts as well as elite
510 ones. Firstly, similar contexts consist of Provençal small agglomerations and cities, from the
511 11th to the 14th centuries AD: (1) Galberto castrum, located at Digne-les-Bains, about 35 km
512 from Castellane (Unsain unpublished); (2) Notre-Dame castrum⁴ (rural part, Allemagne-en-
513 Provence, about 40 km, Unsain 2019); (3) Marseille (city, Rodet-Belarbi, 2011a); (4-5)
514 Marignane (town) and Fos-sur-Mer (castrum near Marseille, Rodet-Belarbi, 2011b ; 2011c).
515 Secondly, this set has been compared with data from neighbouring elite contexts (40-55 km,
516 from the 11th to the 12th centuries AD) such as the castles of the Rocca (6) at Niozelles and
517 the Moutte (7) and Notre-Dame (8) at Allemagne-en-Provence (Leguilloux, 2008 ; 2015 ;
518 Unsain, 2019).

519 This comparison revealed two trends. The first one is specific to modest settlements,
520 whether urban, small town or rural. Here, consumption is mainly focused on sheep/goat
521 (sites 1-3-4-5). However, there are exceptions, such as Notre-Dame, where pigs
522 predominate. This could be an adaptation to a forest area favourable to acorns. The
523 zooarchaeological study of Galberto castrum (density, sFUI and classical analyses) is
524 comparable to Petra Castellana's and provides similar results. It suggests a butcher' s cut
525 and sale, as well as a consumer dynamic, rather than production/consumption. This feature
526 is also suggested by the analysis of sites 3-4-5, although this relies on the slaughter patterns

³ The term "butcher" appeared at the end of the 14th century AD and is associated with inferior quality meat cuts (Wolff, 1953)

⁴ This settlement is divided into two parts: the castle and the "peasant settlement", located below.

527 only. For Galberto, the proximity of the city of Digne-les-Bains, located 6 km away, indicates
528 a probable supply from the city. Indeed, the latter had a strong commercial position (Sclafert
529 1959) and a fair, like the one held in Castellane.

530 The second trend concerns elite occupations in rural areas (very limited data are available
531 for the other elite contexts). Here, a significant proportion of very young pigs and/or goats are
532 observed (three to six months old and ten to 15 months old). The latter would reflect a search
533 for quality meat, in line with the social status of the consumers. The kind of supply is still
534 uncertain. It could have been commercial. In this case, was the network the same as for the
535 rest of the population or was it different? In the city, both possibilities exist. At the Archbishop
536 of Arles and at the *Studium* of Trets (second half of the 14th century AD), texts reveal that an
537 agreement had been made with the communal butcher. These contracts ensured them
538 stable prices all year round (Stouff 1970). At the same time, H. Noizet has shown that the
539 monks of the abbey of Saint-Martin de Tours, in the 13th century AD benefited from a
540 structured network where food was transported by land and river (Noizet 2001, 2002, 2007).
541 The rest of the city had to rely on public (the butcher) and private supplies (Cotté, 2008). For
542 the Provençal castra mentioned above, the lands held by the lords living in the countryside
543 were relatively extensive. In addition, connection to trade routes must have been difficult in
544 these remote areas. A selection from the production of tenant farmers is therefore a more
545 likely hypothesis. It could have consisted of taxes (Carrier, Mouthon 2010), purchases from
546 stockbreeders, or the lords' own produce since farmers are in charge of the herds (Heers,
547 1981).

548
549 The results from Petra Castellana not only contribute to characterise the supply systems of
550 Provençal cities, but also enable a discussion of the supply systems specific to the
551 countryside. It is thus possible to perceive nuances and contrasts between the different
552 components of medieval Provençal society.

553

554 3. Conclusions

555 The results on meat consumption in Petra Castellana are abundant and promising.
556 Although they correspond to the main model identified for Provence (preferential
557 consumption of sheep/goat), they also provide information on the supply system at the site,
558 its surroundings and, more broadly, Provence. Culinary practices have also been discussed.
559 Though it seems that the carving of all three species did not consider the quality of the
560 different meat cuts (by favouring a standardised cut), the cook adapted his or her
561 preparations to the types of meat available (absence of joints, intense consumption of the
562 thorax and differential processing for the different limb sections). In addition, the cutting

563 techniques (material and skills) and textual sources relating to the site suggest that it was a
564 professional job.

565 It is currently not possible to determine the economic status of the two settlements from the
566 11th and the 12th centuries AD. There could have been an economic space in both Petra
567 Castellana and Castellane, or one of the two supplied both itself and the other. However,
568 given the close distance between the two, it is possible to consider them as two districts of
569 the same city.

570 As the data focus mainly on small areas of the site, it is necessary to extend the excavation
571 to other areas. Further work could help determine if these are isolated results, reflecting
572 either a bias in the composition of the assemblage, a specific private consumption or a
573 recurrent model. For now, these data suggest the presence of a butcher in the vicinity of
574 Petra Castellana rather than a travelling butcher. This zooarchaeological study, carried out
575 using an updated protocol (*e.g.*, density and utility indices) as opposed to previous French
576 medievalist approaches, has altered the models of livestock rearing and consumption
577 proposed by historians and zooarchaeologists to date. **Furthermore, the method for
578 discussing the butcher/consumer distinction needs to be further developed. Indeed, since the
579 consumer's perspective is not easily palpable to historians, this would encourage new
580 debates.**

581

SHEEP/GOAT				CATTLE				PIG			
ANATOMICAL PART	NIS P	MN E	MNI c	ANATOMICAL PART	NIS P	MN E	MNI c	ANATOMICAL PART	NIS P	MN E	MNIc
Horn-cores	6	4	3	Horn-cores	2	1	1	Skull	8	2	2
Skull	17	3	3	Skull	12	3	3	Mandible	24	7	5
Mandible	29	11	6	Mandible	5	2	1	Atlas	1	1	1
Hyoid	1	1	1	Hyoid	0	0	0	Axis	0	0	0
Atlas	5	3	3	Atlas	1	1	1	Cervical vertebrae	4	3	1
Axis	5	2	2	Axis	0	0	0	Thoracic vertebrae	3	3	1
Cervical vertebrae	6	1	1	Cervical vertebrae	1	1	1	Rib	14	10	1
Thoracic vertebrae	8	5	1	Thoracic vertebrae	5	2	1	Scapula	4	4	2
Lumbar vertebrae	7	3	1	Lumbar vertebrae	2	1	1	Humerus PJ	0	0	0
Sacral vertebrae	1	1	1	Sacral vertebrae	0	0	0	Humerus PD	1	1	1
Rib	17	15	1	Rib	24	4	1	Humerus MP	4	4	3
Scapula	20	12	8	Scapula	4	2	2	Humerus DD	7	5	3
Humerus PJ	3	2	2	Humerus PJ	4	4	1	Humerus DJ	7	6	3
Humerus PD	3	3	1	Humerus PD	4	3	2	Radius PJ	5	5	4
Humerus MP	10	7	3	Humerus MP	2	2	1	Radius PD	5	5	4
Humerus DD	11	10	5	Humerus DD	3	3	2	Radius MD	2	2	2
Humerus DJ	13	13	7	Humerus DJ	1	1	1	Radius DD	1	1	1
Radius PJ	10	10	5	Radius PJ	1	1	1	Radius DJ	0	0	0
Radius PD	18	14	10	Radius PD	3	3	2	Ulna PJ	0	0	0
Radius MD	18	13	4	Radius MD	2	2	1	Ulna PD	2	2	2
Radius DD	17	16	6	Radius DD	1	1	1	Ulna DD	0	0	0
Radius DJ	3	2	3	Radius DJ	2	2	1	Carpal	0	0	0
Ulna PJ	5	5	5	Ulna PJ	0	0	0	Metacarpal III PJ	0	0	0
Ulna PD	7	7	2	Ulna PD	0	0	0	Metacarpal III MD	0	0	0
Ulna DD	5	5	1	Ulna DD	1	1	1	Metacarpal III DJ	0	0	0
Carpal	4	4	1	Carpal	3	1	1	Metacarpal IV PJ	0	0	0
Metacarpal PJ	6	6	4	Metacarpal PJ	1	1	1	Metacarpal IV MD	0	0	0
Metacarpal MD	3	2	1	Metacarpal MD	1	1	1	Metacarpal IV DJ	0	0	0
Metacarpal DJ	4	4	3	Metacarpal DJ	1	1	1	Sacrum	0	0	0
Sacrum	2	1	1	Sacrum	2	1	1	Coxal	5	3	3
Coxal	10	10	6	Coxal	11	5	3	Femur PJ	0	0	0
Femur PJ	5	5	2	Femur PJ	0	0	0	Femur PD	2	1	1
Femur PD	7	5	4	Femur PD	0	0	0	Femur MD	2	1	1
Femur MD	9	7	3	Femur MD	3	2	2	Femur DD	2	2	2
Femur DD	11	11	8	Femur DD	3	3	3	Femur DJ	0	0	0
Femur DJ	2	2	1	Femur DJ	0	0	0	Patella	0	0	0
Patella	3	3	2	Patella	0	0	0	Tibia PJ	0	0	0
Tibia PJ	2	2	1	Tibia PJ	0	0	0	Tibia PD	6	5	3
Tibia PD	29	10	5	Tibia PD	2	2	2	Tibia MD	5	5	3
Tibia MD	13	11	6	Tibia MD	3	2	2	Tibia DD	2	2	2
Tibia DD	13	11	5	Tibia DD	3	2	2	Tibia DJ	0	0	0
Tibia DJ	3	2	4	Tibia DJ	0	0	0	Calcaneum	2	2	1
Malleolus	1	1	1	Malleolus	0	0	0	Talus	1	1	1
Calcaneum	5	3	2	Calcaneum	1	1	1	Metatarsal III PJ	1	1	1
Talus	8	6	5	Talus	0	0	0	Metatarsal III MD	1	1	1
Tarse	4	3	3	Tarse	0	0	0	Metatarsal III DJ	1	1	1
Metatarsal PJ	11	5	4	Metatarsal PJ	0	0	0	Metatarsal IV PJ	0	0	0
Metatarsal MD	7	5	3	Metatarsal MD	0	0	0	Metatarsal IV MD	0	0	0
Metatarsal DJ	7	7	3	Metatarsal DJ	0	0	0	Metatarsal IV DJ	0	0	0
Phalanx 1	12	8	1	Phalanx 1	2	2	1	Phalanx 1	2	1	1
Phalanx 2	2	2	1	Phalanx 2	1	1	1	Phalanx 2	5	4	1
Phalanx 3	3	3	1	Phalanx 3	1	1	1	Phalanx 3	2	2	1

SKELETAL PART	CODE	% MAU			DENSITY INDICES			FOOD UTILITY INDEX		
		CAPRINE	BOS TAURUS	SUS SCROFA	CAPRINE	BOS TAURUS	SUS SCROFA	CAPRINE	BOS TAURUS	SUS SCROFA
Skull	SK	37,5	100,0	57,1	no data	no data	no data	no data	no data	14
Mandible	MD7	68,8	33,3	100,0	no data	no data	0,38	30	14,2	13
Atlas	AT2	37,5	33,3	28,6	0,1	0,91	no data	19	no data	15
Axis	AX2	25,0	0	0,0	0,1	0,38	no data	19	6,4	15
Cervical vertebrae	CE1	2,5	6,7	17,7	0,1	0,37	no data	55	7,8	15
Thoracic vertebrae	TH1	4,8	5,1	6,1	0,2	0,42	no data	46	56,6	100
Rib	RI2	7,2	5,1	10,2	no data	no data	no data	100	82,9	100
Scapula	SC1	75,0	33,3	57,1	0,3	0,27	0,66	45	100	12
Humerus PJ	H1	12,5	66,7	0,0	0,2	0,24	0,21	37,28	31,6	12
Humerus PD	H2	12,5	50,0	14,3	0,2	0,25	0,22	37,28	31,6	12
Humerus MP	H3	43,8	33,3	57,1	0,5	0,45	0,43	32,79	31,6	10
Humerus DD	H4	62,5	50,0	71,4	0,4	0,48	0,41	32,79	25,1	10
Humerus DJ	H5	81,3	16,7	85,7	0,3	0,38	0,39	32,79	25,1	10
Radius PJ	R1	62,5	16,7	71,4	0,3	0,48	0,45	24,3	25,1	6
Radius PD	R2	87,5	50,0	71,4	0,3	0,56	0,54	24,3	16,5	6
Radius MD	R3	81,3	66,7	28,6	0,9	0,62	0,56	20,06	16,5	4
Radius DD	R4	100,0	16,7	14,3	0,2	0,42	0,42	20,06	12,1	4
Radius DJ	R5	12,5	33,3	0,0	0,3	0,35	0,4	20,06	12,1	4
Ulna PJ	U1	31,3	0	0,0	0,2	0,34	3	no data	12,1	6
Ulna PD	U2	43,8	0,0	28,6	0,3	0,69	3	no data	20,8	6
Ulna DD	U3	31,2	16,7	0,0	no data	no data	3	no data	20,8	no data
Carpal	CP	8,3	5,6	0,0	no data	no data	no data	no data	12,1	3
Metacarpal PJ	MC1	31,3	16,7	-	0,3	0,59	-	10,11	6,6	-
Metacarpal MD	MC2	12,5	16,7	-	0,7	0,63	-	8,45	3,9	-
Metacarpal DJ	MC3	18,8	16,7	-	0,4	0,69	-	8,45	2,6	-
Metacarpal III PJ	MCIII1	-	-	0,0	-	-	0,4	-	-	2
Metacarpal III MD	MCIII2	-	-	14,3	-	-	0,45	-	-	1
Metacarpal III DJ	MCIII3	-	-	0,0	-	-	0,39	-	-	1
Metacarpal IV PJ	MCIV1	-	-	0,0	-	-	0,42	-	-	2
Metacarpal IV MD	MCIV2	-	-	0,0	-	-	0,59	-	-	1
Metacarpal IV DJ	MCIV3	-	-	0,0	-	-	0,48	-	-	1
Sacrum	SA1	12,5	33,3	0,0	0,2	0,27	no data	-	2,6	29
Coxal	AC1	62,5	83,3	42,9	0,3	0,53	0,4	81,5	no data	29
Femur PJ	F1	31,3	0	0,0	0,3	0,31	0,34	80,58	no data	31
Femur PD	F3	31,3	0	14,3	0,1	0,34	0,39	80,58	69,4	31
Femur MD	F4	43,8	33,3	14,3	0,1	0,45	0,51	80,58	69,4	31
Femur DD	F5	68,8	50,0	28,6	0,3	0,36	0,41	80,58	69,4	31
Femur DJ	F6	12,5	0	0,0	0,2	0,26	0,23	80,58	69,4	31
Patella	PA1	18,8	0	0,0	0,4	no data	no data	no data	no data	no data
Tibia PJ	T1	12,5	0	0,0	0,2	0,41	0,3	51,99	69,4	18
Tibia PD	T2	62,5	0	14,3	0,2	0,58	0,29	51,99	40,8	18
Tibia MD	T3	68,8	50	14,3	0,8	0,76	0,5	37,7	40,8	12
Tibia DD	T4	68,8	33,3	28,6	0,5	0,44	0,39	37,7	25,5	12
Tibia DJ	T5	25,0	0	0,0	0,3	0,41	0,48	37,7	25,5	12

Calcaneum	CALC3	18,8	16,7	28,6	0,3	0,49	0,6	23,08	25,5	6
Talus	ASTR1	37,5	0	14,3	0,4	0,72	0,35	23,08	13,6	6
Metatarsal PJ	MT1	31,3	0	-	0,3	0,52	-	15,77	13,6	-
Metatarsal MD	MT2	31,3	0	-	0,6	0,59	-	12,11	7,5	-
Metatarsal DJ	MT3	43,8	0	-	0,4	0,67	-	12,11	4,5	-
Metatarsal III PJ	MTIII1	-	-	14,3	-	-	0,3	-	-	4
Metatarsal III MD	MTIII2	-	-	14,3	-	-	0,48	-	-	2
Metatarsal III DJ	MTIII3	-	-	14,3	-	-	0,46	-	-	2
Metatarsal IV PJ	MTIV1	-	-	0,0	-	-	0,26	-	-	4
Metatarsal IV MD	MTIV2	-	-	0,0	-	-	0,41	-	-	2
Metatarsal IV DJ	MTIV3	-	-	0,0	-	-	0,48	-	-	2
Phalanx 1	P11	25,0	16,7	1,8	0,4	0,48	0,49	8,22	4,5	1
Phalanx 2	P21	6,3	8,3	7,1	0,3	0,41	0,4	8,22	2,4	1
Phalanx 3	P31	9,4	8,3	3,6	0,3	0,32	0,29	8,22	2,4	1

585

586 *Table 2: %MAU, density indices, sFUI (standardized Food Utility Index) and codes for skeletal parts of*
587 *Sheep/goat (Ovis aries & Capra hircus), Bos taurus and Sus scrofa. Bones that are both missing in the*
588 *assemblage and without any indices are not presented. PJ: proximal joint; PD: proximal diaphysis; MD: medial*
589 *diaphysis; DD: distal diaphysis; DJ: distal joint. Indices from Binford, 1978; Lyman, 1994; Ioannidou, 2003.*

590

591

592

593

594

595

596 **Acknowledgments:**

597 First of all, we would like to warmly thank the anonymous reviewers for their involvement,
598 advice and kindness.

599

600 The project PATHWAY leading to this publication has received funding from Excellence
601 Initiative of Aix-Marseille University – A*MIDEX, a French « Investissements d’Avenir »
602 programme.

603 The first author would like to thank in particular Aix Marseille University, which funds this
604 research through a doctoral contract. She also wants to thank the Departmental Archaeology
605 Service of Alpes-de-Haute-Provence (04), first directed by Mathias Dupuis and then by
606 Vincent Buccio, for their trust in letting her conduct the zooarchaeological study.

607

608 We would like to express our gratitude to Jean-Philip Brugal (LAMPEA, UMR 7269) for the
609 collection of comparative anatomy he has made available.

610 We also thank Dr Karina Gerdau for reviewing the manuscript, as well as Isabelle Rodet-
611 Belarbi and Lionel Gourichon (CEPAM, UMR 7264) for their valuable advice.

612 Bibliographic references

613

614 ADAMSON M.W., 2004, *Food in medieval times*, Westport, Conn, Greenwood Press, coll. « Food
615 through history », 256 p.

616 Albarella, U., 2004, "Meat production and consumption in town and country", in Giles, Kate and
617 Dyer, Christopher (eds.), *Town and country in the middle ages: contrasts, contacts and*
618 *interconnections 1100 - 1500*, *Society for Medieval Archaeology*, 22, 131-148.

619

620 AUDOIN F.; MARINVAL-VIGNE M.-C., 1987, « Boucherie médiévale et moderne dans le Val-de-Loire
621 (France) ? », *Anthropozoologica*, NS, 1, coll. « La découpe et le partage du corps à travers le temps et
622 l'espace », 45-52.

623 AUDOIN-ROUZEAU F., 1986, *Ossements animaux du Moyen-Âge au Monastère de La Charité-sur-Loire*,
624 Paris, Publications de la Sorbonne, coll. « Histoire ancienne et médiévale / Université de Paris I », 18,
625 166 p.

626 BAKER P., 1993, « Le rôle de la chasse comme moyen de subsistance durant le haut Moyen Âge dans
627 le nord de l'Italie : une comparaison des sources zooarchéologiques et historiques »,
628 *Anthropozoologica*, HS, 1, 505-516.

629 BARONE R., 1976, *Anatomie comparée des mammifères domestiques : fasc. 1-2. Ostéologie*, Vigot
630 frères., Paris, Vigot, 442 p.

631 BARTOSIEWICZ L., 1995, « Cattle trade across the Danube at Vác (Hungary) », *Anthropozoologica*,
632 21, 189-195.

633 BERTIN L.; SALADIÉ P.; LIGNEREUX Y.; MOIGNE A.M.; BOULBES N., 2017, « The exploitation of equids in the
634 middle ages on the Clos d'Ugnac archaeological site (Pennautier, Aude, France) », *Journal of*
635 *Archaeological Science: Reports*, 15, 179-193.

636 BINFORD L.R., 1978, « Dimensional Analysis of Behaviour and Site Structure: Learning from an Eskimo
637 Hunting Stand », *American Antiquity*, 43, 03, 330-361.

638 BRIDAULT A.; VIGNE J.D.; MASHKOUR M.; FIQUET P.; HORARD-HERBIN M.P., 2000, « Wild boar - age at death
639 estimates: the relevance of new modern data for archaeological skeletal material. 1. Presentation on
640 the corpus. Dental and epiphyseal fusion ages », *Anthropozoologica*, 31, 11-18.

641 BRINK J.W., 1997, « Fat Content in Leg Bones of *Bison bison*, and Applications to Archaeology »,
642 *Journal of Archaeological Science*, 24, 3, 259-274.

643 BRUGAL J.-P.; DAVID F.; FARIZY C., 1994, « Quantification d'un assemblage osseux: paramètres et
644 tableaux : Actions anthropiques », *Artefacts*, 9, 143-153.

645 BURRI S., DURAND A.; PY V.; VASCHALDE C., 2013, « Les outils pour acquérir et transformer la matière
646 ligneuse dans les chaînes opératoires techniques des artisanats forestiers en Provence et Haut-
647 Dauphiné au Moyen Âge », dans *XXXIIIes Journées internationales d'histoire et d'archéologie*
648 *d'Antibes, Octobre 2012*, Antibes, 397-414.

649 Buccio, V., Dantec, E., Dedonder, Y., Devos, J.-F., 2018. *Castellane (04039) - Petra Castellana*. Rapport
650 de fouille programmée, SRA PACA, Aix-en-Provence, 224 p.

651

- 652 Carrier, N., Mouthon, F., 2010. *Paysans des Alpes : les communautés montagnardes au Moyen Âge*,
653 Histoire. Presses Universitaires de Rennes, Rennes, 417 p.
654
- 655 CATALO J., RODET-BELARBI I.; LIGNEREUX Y., 1995, « Déchets de boucherie et alimentation au XIVe siècle à
656 l'hôpital du pas à Rodez (Aveyron) », *Archéologie du Midi médiéval*, 13, 1, 187-195.
- 657 COSTAMAGNO S.; RIGAUD J.-P., 2013, « L'exploitation de la graisse au Paléolithique », in *138e Congrès*
658 *national des sociétés historiques et scientifiques*, Rennes, 135-152.
- 659 COTTE O., 2008, *La société urbaine à Tours et l'animal (14e-17e s.): approche archéozoologique*, Thèse
660 de doctorat, UNIVERSITÉ FRANÇOIS - RABELAIS, Tours, 574 p.
- 661 DAVIS S.J.M., 2008, « Zooarchaeological evidence for Moslem and Christian improvements of sheep
662 and cattle in Portugal », *Journal of Archaeological Science*, 35, 4, 991-1010.
- 663 DURAND A.; FOREST V.; GARDEISEN A.; RUAS M.P., 1997, « Approches bioarchéologiques de l'habitat
664 castral languedocien - Huit sites de la bordure méridionale du Massif central (Xe - XVIe siècle) »,
665 *Histoire et Sociétés rurales*, 8, 11-32.
- 666 FERNANDEZ H., 2001, *Ostéologie comparée des petits ruminants eurasiatiques sauvages et*
667 *domestiques (genres Rupicapra, ovis, Capra et Capreolus) : diagnose différentielle du squelette*
668 *appendiculaire*, Thèse de doctorat, Université de Genève, faculté des sciences, Genève, 590 p.
- 669 FERRIERES M., 2002, *Histoire des peurs alimentaires : du Moyen Âge à l'aube du XXe siècle*, Paris, ed.
670 du Seuil, coll. « Points Histoire », 359, 474 p.
- 671 FLANDRIN J.L.; MONTANARI M.; SONNENFELD A. (ED.), 1999, *Food: a culinary history from Antiquity to the*
672 *present*, New York, Columbia University Press, coll. « European perspectives », 592 p.
- 673 FOREST V., 1987, *Vestiges fauniques osseux du Xe au XIVe siècle en Rhône-Alpes*, Thèse de doctorat,
674 Ecole Nationale Vétérinaire de Lyon, Lyon, France, 110 p.
- 675 Forest, V., 1998. « Des restes osseux fauniques aux types d'élevage : identification d'innovations ». *in: Société d'archéologie médiévale*. Presented at the VIe Congrès international d'Archéologie
676 Médiévale (1-5 octobre 1996, Dijon - Mont Beuvray - Chenôve - Le Creusot - Montbard), *Société*
677 *d'Archéologie Médiévale*, Caen, 15-20.
678
679
- 680 GARCÍA-GARCÍA M., 2017, « Some remarks on the provision of animal products to urban centres in
681 medieval Islamic Iberia: The cases of Madinat Ilbirah (Granada) and Cercadilla (Cordova) », *Quaternary International*, 460, 86-96.
682
- 683 GAUTIER A., 2013, « Cooking and cuisine in late Anglo-Saxon England », *Anglo-Saxon England*,
684 41, 373-406.
- 685 GRAU-SOLOGESTOA I., 2015, « Livestock management in Spain from Roman to post-medieval times: a
686 biometrical analysis of cattle, sheep/goat and pig », *Journal of Archaeological Science*, 54, p. 123-134.
- 687 GREENFIELD H.J.; ARNOLD E.R., 2008, « Absolute age and tooth eruption and wear sequences in sheep
688 and goat: determining age-at-death in zooarchaeology using a modern control sample », *Journal of*
689 *Archaeological Science*, 35, 4, 836-849. DOI: 10.1016/j.jas.2007.06.003
- 690 HEERS J., 1981, *Esclaves et domestiques au Moyen Age dans le monde méditerranéen*, Paris, Fayard,
691 296 p.

- 692 HELMER D., 2000, « Discrimination des genres *Ovis* et *Capra* à l'aide des prémolaires inférieures 3 et 4
693 et interprétation des âges d'abattage : l'exemple de Dikili Tash (Grèce) », *Anthropozoologica*,
694 31, 29-38.
- 695 HORARD M.-P.; LAURIOUX B. (ed.), 2017, *Pour une histoire de la viande : fabrique et représentation de*
696 *l'Antiquité à nos jours*, Rennes, Presses Universitaires de Rennes, coll. « Table des Hommes », 464 p.
- 697 HORARD-HERBIN M.-P., 1997, « Le village celtique des Arènes à Levroux. L'élevage et les productions
698 animales dans l'économie de la fin du second âge du Fer - Levroux 4 », *Fédération pour l'édition de la*
699 *Revue archéologique du Centre de la France*, Supplément à la Revue archéologique du centre de la
700 France, 12, 3-206.
- 701 IOANNIDOU E., 2003, « Taphonomy of Animal Bones: Species, Sex, Age and Breed Variability of Sheep,
702 Cattle and Pig Bone Density », *Journal of Archaeological Science*, 30, 3, 355-365.
- 703 JONES K.T.; METCALFE D., 1988, « Bare bones archaeology: Bone marrow indices and efficiency »,
704 *Journal of Archaeological Science*, 15, 4, 415-423.
- 705 Jones, G.G., Sadler, P., 2012, "A review of published sources for age at death in cattle."
706 *Environmental Archaeology* 17, 1–10. <https://doi.org/10.1179/1461410312Z.0000000001>
707
- 708 KREUTZER L.A., 1992, « Bison and deer bone mineral densities: Comparisons and implications for the
709 interpretation of archaeological faunas », *Journal of Archaeological Science*, 19, 3, 271-294.
- 710 LECUYER N., 1997, « Cuisine languedocienne, cuisine méditerranéenne ? Approche anthropologique
711 de la vaisselle céramique méridionale (Xe - XIVe siècle) », *Archéologie du Midi médiéval*,
712 15, 1, 235-243.
- 713 LEGUILLOUX M., 1994, *L'archéozoologie et l'interprétation des sites : recherches archéozoologiques sur*
714 *la Provence romaine et médiévale*, Thèse de doctorat, Université de Provence, Aix-en-Provence,
715 860 p.
- 716 LEGUILLOUX M., 2008, « La faune », dans *Mottes castrales en Provence : les origines de la fortification*
717 *privée au Moyen Âge*, Paris, Maison des sciences de l'homme, coll. « Documents d'archéologie
718 française », 102, 53-59.
- 719 LEGUILLOUX M., 2015, « L'exploitation des ressources animales », dans *La Moutte d'Allemagne-en-*
720 *Provence : un castrum précoce du Moyen Âge provençal*, Errance., Aix-en-Provence, coll. « Centre
721 Camille Jullian », 117-138.
- 722 LEWICKA P.B., 2011, *Food and foodways of medieval Cairenes: aspects of life in an Islamic metropolis*
723 *of the eastern Mediterranean*, Leiden ; Boston, Brill, coll. « Islamic history and civilization : studies
724 and texts », 626 p.
- 725 LIGNEREUX Y.; PETERS J., 1996, « Techniques de boucherie et rejets osseux en Gaule romaine »,
726 *Anthropozoologica*, 24, 45-97.
- 727 LYMAN R.L., 1994, *Vertebrate taphonomy*, Cambridge; New York, Cambridge University Press, 524 p.
- 728 LYMAN R.L., 1994b, "Quantitative Units and Terminology in Zooarchaeology". *American Antiquity* 59,
729 36–71. <https://doi.org/10.2307/3085500>
730
731

- 732 MATSCHKE G.H., 1967, « Aging European Wild Hogs by Dentition », *The Journal of Wildlife*
733 *Management*, 31, 1, 109.
- 734 MONTANARI M., 1988, *Alimentazione e cultura nel Medioevo*, Bari; Roma, Laterza, 224 p.
- 735 MONTANARI M., 1993, *Fame e l'abbondanza: Storia dell'alimentazione in Europa*, Bari, It.: Editori
736 Laterza, 262 p.
- 737 MONTANARI M., 2015, *Medieval tastes: food, cooking, and the table*, New York, Columbia University
738 Press, coll. « Arts and traditions of the table, perspectives on culinary history », 267 p.
- 739 Monteix, N., 2007. « Du couteau au boucher : remarques préliminaires sur la préparation et le
740 commerce de la viande à Pompéi ». *Food and History* 5, 169–196.
741 <https://doi.org/10.1484/J.FOOD.1.100190>
- 742
743 Moriceau, J.-M., 2005. *Histoire et géographie de l'élevage français : XVe-XVIIIe siècles*. Fayard, Paris,
744 477 p.
- 745
746 Noizet, H., 2007. *La fabrique de la ville. Espaces et sociétés à Tours (IXe-XIIIe siècle)*, Publications de la
747 Sorbonne. Paris, 504 p.
- 748
749 Noizet, H., 2002. « Le centre canonial de Saint-Martin de Tours et ses domaines périphériques en Val
750 de Loire (IXe-Xe s) ». *Annales de Bretagne et des pays de l'Ouest*, 109, 9–33.
- 751
752 Noizet, H., 2001. *Le chapitre de Saint-Martin de Tours et la Loire aux IXe-Xe siècles. Géographie de la*
753 *Loire moyenne*, Résultats du PCR 1996-1999, SRA Centre, 47–64.
- 754
755 O'Connor, T.P., 2001, "Animal bone quantification", in: Brothwell, D.R., Pollard, A.M. (Eds.),
756 *Handbook of Archaeological Science*. Wiley & Sons, 703-710.
- 757
758 Payne, S., 1973. "Kill-off Patterns in Sheep and Goats: the Mandibles from Aşvan Kale", *Anatolian*
759 *Studies* 23, 281–303. <https://doi.org/10.2307/3642547>
- 760
761 PETROWISTE J., 2018, « En passant par le mazel. Acheter sa viande au quotidien en France méridionale
762 à la fin du Moyen Âge », dans PETROWISTE J. (ed.), *Faire son marché au Moyen âge : Méditerranée*
763 *occidentale, XIIIe-XVIe siècle*, Madrid, coll. « la Casa Velázquez », 166, 181-207.
- 764 PETROWISTE J.; LAFUENTE GOMEZ M. (ed.), 2018, *Faire son marché au Moyen âge : Méditerranée*
765 *occidentale, XIIIe-XVIe siècle*, Madrid, Casa Velázquez, 282 p.
- 766 Plug, C.; Plug, I., 1990, "MNI Counts as Estimates of Species Abundance", *The South African*
767 *Archaeological Bulletin* 45, 53-57. <https://doi.org/10.2307/3887918>
- 768
769 RODET-BELARBI I., 2011a, « Hôtel-Dieu, étude de la faune par I. Rodet-Belarbi », dans MELLINAND P.;
770 THOMAS N. (dir.), *Bouches-du-Rhône, Marseille, 6 place Daviel et rue des belles écuelles - Hôtel-Dieu*,
771 Nîmes, INRAP, coll. « Rapport final d'opération », 271-277.
- 772 RODET-BELARBI I., 2011b, *La faune : Place du Château - Bouches-du-Rhône, Marignane, Centre ancien*,
773 Rapport de fouille, INRAP, Nîmes, 40-43

- 774 RODET-BELARBI I., 2011c, "Étude de la faune et du travail de l'os" in *Dans les faubourgs médiévaux de*
775 *l'Hauture*, Rapport de fouille, INRAP, Nîmes, 58-68
- 776 RODET-BELARBI I.; FOREST V., 2008, « Alimentation carnée du XIVe au XVIe siècle dans le sud de la
777 France, d'après les sources archéozoologiques : la part des mammifères sauvages et des oiseaux »,
778 *Publications du CRAHM*, p. 159-178, coll. « La cuisine et la table dans la France de la fin du Moyen
779 Âge », 159-178.
- 780 ROWLEY-CONWY P., HALSTEAD P.; COLLINS P., 2002, « Derivation and Application of a Food Utility Index
781 (FUI) for European Wild Boar (*Sus scrofa* L.) », *Environmental Archaeology*, 7, 1, 77-88.
- 782 SCLAFERT T., 1959, *Cultures en Haute-Provence : déboisements et pâturages au Moyen Âge*, Paris,
783 S.E.V.P.E.N, coll. « Les Hommes et la terre », 271 p.
- 784 Seetah, K., 2002, "Multidisciplinary Approach to Romano-British Cattle Butchery", in: *Integrating*
785 *Zooarchaeology*. Durham, 111–118.
- 786
787 STOUFF L., 1970, *Ravitaillement et alimentation en Provence aux XIVe et XVe siècles*, Paris; La Haye,
788 Mouton, 507 p.
- 789 UNSAIN D., 2019, « Nouveau regard sur l'alimentation carnée en Provence médiévale : les apports de
790 l'archéozoologie », dans *Hommes et caprinés : de la montagne à la steppe, de la chasse à l'élevage*
791 *Humans and caprines : from mountain to steppe, from hunting to husbandry XXXIXe rencontres*
792 *internationales d'archéologie et d'histoire d'Antibes*, Antibes, Éditions APDCA, 297-314
- 793 Villa, P., Mahieu, E., 1991, "Breakage patterns of human long bones. *Journal of Human Evolution*" 21,
794 27–48. [https://doi.org/10.1016/0047-2484\(91\)90034-S](https://doi.org/10.1016/0047-2484(91)90034-S)
- 795
796 Wolff, P., 1953. « Les bouchers de Toulouse du XIe au XVe siècle ». *Annales du Midi* 65, 375–393.
797 <https://doi.org/10.3406/anami.1953.5927>
- 798
799 WOOLGAR C.M. (ed.), 2006, *Food in medieval England: diet and nutrition*, Oxford, Oxford Univ. Press,
800 coll. « Medieval history and archaeology », 347 p.
- 801 ZEDER M.A., 2009, « 6. Reconciling Rates of Long Bone Fusion and Tooth Eruption and Wear in Sheep
802 (*Ovis*) and Goat (*Capra*) », dans RUSCILLO D. (ed.), *Recent Advances in Ageing and Sexing Animal*
803 *Bones*, Oxford, England, Oxbow Books, 87-118.
- 804 ZEDER M.A.; LEMOINE X.; PAYNE S., 2015, « A new system for computing long-bone fusion age profiles in
805 *Sus scrofa* », *Journal of Archaeological Science*, 55, 135-150.
- 806 Zeder, M.A., Lapham, H.A., 2010, "Assessing the reliability of criteria used to identify postcranial
807 bones in sheep, *Ovis*, and goats, *Capra*". *Journal of Archaeological Science* 37, 2887–2905.
808 <https://doi.org/10.1016/j.jas.2010.06.032>