New perspectives on Late Bronze Age lagoon sites in the South of France revealed by animal exploitation at the La Motte I site (Hérault)

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1 Title

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21 Abstract

At the present time, only a few Late Bronze Age sites in the French Mediterranean have yielded faunal data. The newly excavated site of La Motte I (Hérault, France) is exceptionally well preserved owing to its underwater context. The discovery of large quantities of pottery, a wattle and some wooden poles allowed the site to be dated to the Late Bronze Age IIIb (900-775 BC). The zooarchaeological analysis of the mammalian remains has made it possible to identify the nature of butchery operations at the site. Culling profiles show herd management practices during this period and bring to light specific dietary practices. These data reveal meat procurement behaviour in this Bronze Age Mediterranean population, highlighting regular meat acquisition from domestic livestock.

Highlights:

- Zooarchaeological analysis of an exceptionally well-preserved Late Bronze Age lagoon occupation in Mediterranean southern France.
- Food production is strongly oriented towards land-based resources despite the proximity of the lagoon and the sea.
- Meat consumption of this Late Bronze Age Mediterranean population was mainly composed of young domestic animals.

Keywords: Late Bronze Age; French Mediterranean; culling profile; herd management; lagoons

1. Introduction

The Bronze Age and the beginning of the Iron Age in France are the subject of a recent overview (Carozza *et al.*, 2017). This evaluation of French data for the Late Bronze Age indicates a hierarchical organisation, linked to elite status. There is clear evidence for the expansion of fortified settlements, located at strategic locations such as confluence points or on rocky outcrops. While housing data and archaeological evidence (ceramics, metal tools, structures) are available, zooarchaeological analyses

are still comparatively rare. Indeed, faunal data in Languedoc at the end of the Bronze Age (Final Bronze IIIb) are extremely scant. Most of the zooarchaeological studies for Languedoc deal with earlier periods or different contexts, such as Castelvieu Cave for the Final Bronze IIIa (Gardeisen, 1991) or Les Courtinals settlement for the Final Bronze II and IIIa (Poulain, 2002). For the Final Bronze IIIb, they mainly consist of simple faunal lists accompanied by basic interpretation (Columeau, 1985; 2002). However, rescue archaeology has sparked new interest in this period among researchers for the Mediterranean region of France. Moreover, the French Mediterranean context differs slightly from Late Bronze Age continental sites, both in terms of chronology (Table 1) and culture, as it is influenced by the proximity of Iberia and Italy, and presents specific local characteristics (Garcia and Vital, 2006; Gascó, 1998; Lachenal, 2014; Py, 2012).

Datation B.C	Southern French chronology	French chronology	German chronology	British chronology	
650	Bronze/Iron Transition	Ancient Hallstatt	Hallstatt C	Early Iron Age	
700					
800	Final Bronze IIIb	Final Bronze IIIb	Hallstatt B2/3	Later Bronze Age	
900					
1000	Final Bronze IIIa	Final Bronze IIIa	Hallstatt B1		
1100	Final Bronze IIb				
		Final Bronze IIb	Hallstatt A2		
1200	Final Bronze IIa	Final Bronze IIa	Hallstatt A1		Middle Bronze Age
	Final Bronze Ib				
1300	Final Bronze Ia	Final Bronze I	Bronze D		

1400				
	Middle Bronze 2	Middle Bronze 2	Bronze C2	

Tab. 1: Comparative chronology of the Late Bronze Age and beginnings of the Iron Age in Europe.

The present zooarchaeological analysis provides new perspectives on the way of life of these Mediterranean populations. Geomorphological studies show that the housing site of La Motte I was located on the edge of a former lagoon (Devillers *et al.*, forthcoming), suggesting that it was mainly organized around maritime resources. However, this study shows that terrestrial resources appear to supply important staple foods for these inhabitants. It is clear that such specific types of sites must be compared to previously studied sites (Columeau, 1985) in Languedoc and in the North of France, such as Boulancourt (Seine-et-Marne) and sites in Aisne (Auxiette, 1997; Bălăşescu *et al.*, 2008; Carozza *et al.*, 2017). These sites date from the Late Bronze Age and should reveal whether there are similarities in meat consumption between southern and northern France.

Lagoon complexes in the Gulf of Lion (Fig. 1) offered an attractive area for Bronze Age populations. Indeed, lagoons are convenient locations, with a variety of readily available food resources and nearby cultivable land. The first excavations of such sites began in 1940 at the Bages-Sigean lagoon (Guy, 1950). Interest in them was subsequently revived after the discovery of protohistoric settlements in the Lez Delta, such as Port Ariane in Lattes, Hérault (Daveau, 2007). Local archaeologists discovered several sites (Fig. 1) on the edge of the Or Lagoon (Arnal and Prades, 1980; Dedet *et al.*, 1985; Prades, 1974), in the Thau Lagoon (Courtin, 1978; Leroy *et al.*, 2003) and in Vendres (Carozza and Burens, 2000). The Or Lagoon sites were first considered to be transient sites, on herd transhumance routes (Py, 1990). In other words, it was thought that local populations lived near the coast in summer with their herds and moved with them during the wet season to high-altitude sites in mountainous areas. But this hypothesis has since been challenged by recent

paleobotanical studies (Bouby, 2014) and the Portal-Vielh excavations (Carozza and Burens, 2000), which show that these lagoon habitats were used year-round.

2. Site presentation

Fig. 1: Geographical location of the archaeological site of La Motte I (CAD, T.Lachenal), modified.

La Motte I is situated in the South of France near the town of Agde (Fig.1). The underwater site is currently submerged in the Hérault River and was discovered by the IBIS diving association in 2002. During the first excavations in 2004, a hoard consisting of an almost complete set of feminine finery was discovered (Moyat *et al.*, 2010; Verger *et al.*, 2007). Surveys were then conducted by J. Gascó and T. Lachenal in 2011 and are still ongoing (Gascó *et al.*, 2015). A planimetric survey and excavations were carried out by divers at two different sites on either side of the river bed and cover 3,000 m² (Fig. 2).

Fig 2 (in colour): Map of the excavation of La Motte I in the Hérault River with detailed view of the wattle (CAD, T. Lachenal), modified.

This housing site was originally located on the edge of a former lagoon (Devillers *et al.*, forthcoming), which has since been filled with sediments from the Hérault. The remains are immersed under five metres of water and, as a result, are exceptionally well preserved. The large quantity of organic remains in the sediments allows for a precise reconstruction of the evolution of the paleoenvironment and human activities. Ten wooden poles were radiocarbon dated and gave dates ranging from the ninth to eighth centuries B.C. (Gascó *et al.*, 2015). These dates are consistent with the analysis of pottery (Lachenal *et al.*, 2017) corresponding to the Late Bronze Age (ninth to early eighth centuries) and linked to the establishment of the Mailhac I culture in Languedoc (Gailledrat *et al.*, 2007; Janin, 2000; Louis *et al.*, 1955). The site also presents riverbank structures, comprising imported basalt rocks and wattle, demonstrating the reinforcement of the banks and the

delimitation of an inhabited zone. The hypothesis of a semi-nomadic way of life for these lagoon populations (Py, 1990) has been challenged by recent discoveries. Therefore, the question of permanent settlement at La Motte I remains open. Nevertheless, the excavated levels in which the faunal remains were discovered are primarily waste deposits in the vicinity of the dwelling area and are close to the riverbank structures. In addition, the carpological analysis (Bouby *et al.*, 2016) revealed that the population living at the site was actively involved in agricultural production and practised herd stalling. These factors suggest perennial settlement for the La Motte I site. The analysis of the faunal remains from La Motte I should therefore be expected to confirm these initial results.

3. Materials and methods

Faunal bones and teeth were collected from all excavation areas in different stratigraphic units and in 2m x 2m squares (Sector 1, 2, 3 and 4; Fig. 2). Three samples were collected for the carpological study in the D26 sounding (SU 4, 15 and 18) and in the wattle zone. These samples were sieved but no faunal remains were found. As the entire sequence of stratigraphic units was dated to the end of the Bronze Age, all the faunal remains were analysed (Table A in the appendices) and recorded by stratigraphic unit and square in the Syslat© database.

The complete collection consists of 1,321 mammal, bird, shellfish and fish remains. The shellfish and fish remains are not analysed in this study as they will be studied in detail by other specialists. The taxonomic and anatomical determination was carried out using the reference faunal sampling at the ASM laboratory of the University of Montpellier 3 (CNRS, UMR 5140).

The differential diagnosis between *Capra hircus* and *Ovis aries* teeth (Balasse and Ambrose, 2005; Halstead *et al.*, 2002; Helmer, 2000; Payne, 1985) has been contested (Zeder and Pillar, 2010) but a recent study (Gillis *et al.*, 2011) highlighted the reliability of the combination of several criteria. As the bones are well preserved at La Motte I, most mandibular and maxillary bones contain whole dental series, which facilitated differentiation between sheep and goats. With the post-cranial data,

a primary distinction was made based on morphological criteria (Boessneck, 1969, Zeder and Lapham, 2010) and confirmed by discriminant analysis (Salvagno and Albarella, 2017). The distinction between rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*) was made using specific morphological criteria (Callou, 1997).

The quantification of faunal remains is expressed by the Number of Identified Specimens (NISP), which includes taxonomically and anatomically identified bones and teeth, and the Minimum Number of Individuals combination (MNIc). The MNIc takes into account species, element frequency, pairing, ageing and sex. The complete dental series on the mandible and maxillary and isolated teeth were used to calculate the MNIc index, taking into account eruption sequence and wear. The age at death (AtD) was defined for large bovids using the most accurate method (Legge, 1992; Gillis *et al.*, 2016), in order to be as precise as possible. The use-wear code method was applied to Caprinae (Payne, 1987). To estimate the AtD value of suids, we used a method based on ranking codes (Grant, 1982; Lemoine *et al.*, 2014).

Culling profiles were calculated in accordance with the recommendations of Brochier, who elaborated a statistically correct method that allows for accurate interpretation (Brochier, 2013). Insofar as possible, age analysis was based on bone epiphyseal fusion (Zeder *et al.*, 2015 for Suidae, Reitz and Wing, 1999).

Standard biometrics (Von den Driesch, 1976) were performed on all bones and teeth whenever possible in order to distinguish between *Ovis aries* and *Capra hircus*, *Bos Taurus* and *Bos primigenius*, and to estimate the withers height of the animals. The body size of animals was investigated using reference coefficients for Caprinae (Teichert, 1975), Bovidae (Matolcsi, 1970) and Equidae (Kiesewalter, 1888), to provide a view of the domestic herd present in this region at the end of the Bronze Age.

Skeletal representation is divided into four categories: cranial remains include the skull, mandible and jaw, the axial skeleton is composed of vertebrae and ribs, the limbs include the forelimbs

154 (scapula, humerus, radius and ulna) and hindlimbs (coxal, femur, tibia and fibula) and finally the feet
155 include carpals, tarsals, metapodials and phalanxes. The following indices were used in this study in
156 order to determine whether anatomical parts were differentially deposited (Lyman, 2008; Poplin
157 1976):

158 MNE: Minimum Number of Elements (i.e. a humerus) tallied after virtual reassembly taking into
159 account pairing, ageing and the sex of all bone remains for a species.

160 Qsp: This is the number of given elements in a complete skeleton for a species. It can vary according
161 to age (i.e. number of teeth) and species.

162 MAU: Minimum Animal Unit. This is the frequency of skeletal MNE for a given species.

163 $MAU = MNE / Q_{sp}$

164 %MAU: This is the normalized MAU calculated from the highest MAU corresponding to 100%.

165 $\%MAU = 100 \times MAU / MAU_{max}$

166 PS: The percentage of survivorship is calculated for each element and can be applied to the
167 anatomical region (cranial, axial, limb and foot) and to the entire skeleton using the MAU and MNIC.

168 $PS = 100 \times MNE / MNIC \times Q_{sp}$

169 Bone surface modifications were studied in order to identify their causes and to characterize their
170 impact on bone assembly. The cortical surface of all remains was analysed macroscopically and some
171 specimens were inspected microscopically with a Leica stereomicroscope. The orientation and
172 location of marks on the bone were recorded. The marks were then separated into five categories
173 (Fig. 3): notches associated with large tools forming a large triangular depression; slicing, generally
174 made with a cleaver, exposing a sharp section of the bone; scratches, created by knives and forming
175 fine notches on the cortical surface; cortical removal, made either by cleavers or knives and

characterized by a longitudinal removal of the cortical surface of the bone; and finally, sawing, recognizable by the irregularity of the section's surface caused by the saw.

Fig. 3: Anthropogenic modifications to bone surface. a: slicing (cutting); b: cortical removal; c: notches; d: sawing; e: scratches.

Non-anthropogenic post-depositional marks were also investigated and classified into the following categories: root marks, gnawing by carnivores and rodents, and edaphic marks.

All faunal remains were registered in the Syslat© database (Py 1997; Gardeisen 1997).

4. Results

4.1 Taxon diversity

5 The faunal assemblage of La Motte I is composed of 1,321 remains (total of identified and unidentified faunal remains), including 685 identified bones and teeth (NISP). They belong to fourteen species: cattle (*Bos taurus*), sheep (*Ovis aries*), goats (*Capra hircus*), pigs or wild boars

(*Sus scrofa*), horses (*Equus caballus*), dogs (*Canis lupus familiaris*), deer (*Cervus elaphus*), aurochs (*Bos primigenius*), rabbits (*Oryctolagus cuniculus*), turtles, birds, shellfish and fish (Table 2; Annexes Table A).

FAUNAL LIST		NISP	MNIc
Cattle	<i>Bos taurus</i>	215	49
Aurochs	<i>Bos primigenius</i>	3	1
Suid	<i>Sus scrofa</i>	99	40
Sheep	<i>Ovis aries</i>	26	20
Goat	<i>Capra hircus</i>	44	31
Sheep/Goat	<i>Ovis/Capra</i>	183	35
Horse	<i>Equus caballus</i>	10	6
Dog	<i>Canis lupus familiaris</i>	16	10
Deer	<i>Cervus elaphus</i>	55	16
Rabbit	<i>Oryctolagus cuniculus</i>	24	8
Pond terrapin	<i>Emys orbicularis</i>	2	2
Cormorant	<i>Phalacrocorax sp.</i>	3	2
	<i>Birds indet.</i>	3	3
	<i>Carnivore indet.</i>	1	1
	<i>Microfauna</i>	1	1
Sea bream	<i>Sparus aurata</i>	*	*
	Unidentified	636	
Total	Total	1,321	225

Tab 2: Quantification of the faunal assemblage recovered from the La Motte I site. Number of Identified Specimens (NISP) and Minimum Number of Individuals combination (MNIc). *Although the ichthyofaunal remains will soon be analysed by a specialist, rare *Sparus aurata* remains have already been determined.

Among the species present at La Motte I, the domestic triad (*Bos taurus*, *Ovis aries*/*Capra hircus*, *Sus scrofa*) prevails. Livestock is mainly composed of goats and sheep, which is common in Mediterranean areas (Gardeisen, 1991; Columeau, 1985); followed by cattle and pigs. Horses and dogs are less frequent. Deer is the most hunted wild species, represented by faunal remains mainly composed of bones (only three fragments of antler have been found), followed by rabbit and aurochs (*Bos primigenius*). Some sporadic remains of the European pond terrapin (*Emys orbicularis*), cormorant (*Phalacrocorax sp.*), wild goose (*Anser sp.*), sea bream (*Sparus aurata*) and other unidentified wild birds have also been recorded.

Fig. 4: Comparison of the distribution of the domestic triad in Late Bronze Age sites in France (Columeau, 1985; Forest, 2007; Gardeisen, 1991; Poulain, 2002; Auxiette, 1997).

It is generally accepted that evidence of pig farming generally increased in France at the end of the Bronze Age (Forest, 2000; Auxiette, 1997), with *Sus scrofa* forming more than 20% of the NISP, which is not the case at La Motte. Pig farming developed considerably (more than 30% of the NISP) in many French continental plains (Fig. 4), but not in Mediterranean sites where husbandry practices seemed to focus more on goats or cattle. For example, in the vicinity of the Mauguio pond (Columeau, 1985), caprines predominate, followed by pigs and cattle. In Port-Ariane (Hérault, France), cattle are clearly predominant, which is counter to the classic Mediterranean pattern (Forest, 2007), usually dominated by caprines (mainly sheep and to a lesser degree, goats), then cattle, pigs (about 20% of the faunal assemblage) and deer (about 10%).

The domestic herd of La Motte I is dominated by caprines in terms of NISP and MNIC, and more precisely by goats, with suid livestock coming in third position after cattle. The importance of goats rather than sheep seems to be an original feature of this site. Indeed, at other sites, such as Castelvielh (Gard) or Les Courtinals (Hérault), sheep are the best represented taxon. But this slight difference should be interpreted with caution, as these two sites are dated respectively to the Final Bronze IIIa and Final Bronze II-IIIa and correspond to different types of occupations (cave and hilltop

settlement). This first approach shows that the faunal remains represent classic Late Bronze Age Mediterranean animal husbandry. A group of people settled in a developed settlement with a communal herd sustaining their needs mainly composed of caprines and bovids, followed by suids, with some horses and dogs.

4.2 Body size

Only a few complete bones were available for each taxon for this analysis. Withers height was estimated for caprines on one radius, one metacarpal and two astragali, for *Bos taurus* (one radius, two metacarpals and two metatarsals) and for *Equus caballus* (one femur), (Table 3). The results gave a range of 46.1-56.3 cm for caprines, 103.6-115.6 cm for cattle, and the single whole horse femur gave a height of 136.7 cm. These results can be compared with those of Boulancourt (Seine-et-Marne), Port-Ariane (Hérault) and Castelvieu (Gard). For size estimates at Boulancourt, a single whole metatarsal of *Bos taurus* gave a height estimate of 108.5 cm; a range of 51.8-63.5 cm is given for goats and no data are available for horses. In Port-Ariane, the measurements of a bovine metacarpal and an equine metatarsal indicate an estimated size of 117 and 125 cm, respectively. Caprine bones could not be measured. In Castelvieu, the size of the sheep is between 54 and 60 cm. Despite the small number of measurements and estimates, a trend towards a smaller size for goats and cattle is visible while the La Motte I horse seems larger than horses at the other sites (Table 4). But this comparison is unreliable because the distinction between *Equus asinus* and *Equus caballus* has not been made at other sites.

Species	Bones	GL	Index	Withers height in cm
<i>Ovis/Capra</i>	radius	139.7	4	55.9
	metacarpal	116.3	4.84	56.3
	astragalus	24	19.24	46.1
		24.6		47.3
<i>Bos taurus</i>	radius	237.9	4.3	102.3
	metacarpal	173.5	6.33	109.8

		173.5		109.8
		163.7		103.6
	metatarsal	205.6	5.62	115.6
		203.3		114.3
<i>Equus caballus</i>	femur	389.6	3.51	136.8

Tab. 3: Withers height estimation in cm for caprines (*Ovis/Capra*), cattle (*Bos taurus*) and horses (*Equus caballus*) at La Motte I.

	Castelvielh BFIIIa	Port-Ariane Final Bronze	Boulancourt BFIIIb	La Motte I BFIIIb	Cougourlude Early Iron Age
<i>Ovis aries/ Capra hircus</i>	57	x	58	51	57
<i>Bos taurus</i>	x	113	109	107	111
<i>Equus</i> sp.	x	125	x	137	107

Tab. 4: Comparison of average withers height for caprines, cattle and equids from the archaeological settlements of Port-Ariane (Hérault), La Motte I (Hérault), Cougourlude (Hérault), Castelvielh (Gard) and Boulancourt (Seine-et-Marne).

For wild species, three tarsal elements were identified as *Bos primigenius* on account of their large size. All of the aurochs remains are incomplete, but measurements on a fragmented aurochs astragalus (*Bos primigenius*) reveal that the La Motte I specimen is probably a huge male, similar to the largest European Pleistocene specimens (Wright, 2013) and larger than Holocene specimens (Helmer and Monchot, 2006; Kysely, 2008; Wright and Viner-Daniels, 2015; Wright, 2013). Measurements of this aurochs astragalus were compared with other data from Pleistocene and Holocene sites and clearly show the remarkable height of this animal (Fig. 5). This suggests that the environment at that time was conducive to the presence of an aurochs of remarkable size. This is also confirmed by the carpological analysis (Bouby *et al.*, 2016), which shows the presence of a green oak forest and open spaces with heaths and junipers. It also suggests that the size of domestic animals is more related to domestication and selection effects than environmental conditions.

Fig. 5: Comparison of the measurements (Bd) of the aurochs astragalus (*Bos primigenius*) at La Motte I with other European sites (Wright, 2013; Wright and Viner-Daniels, 2015; Helmer and Monchot, 2006).

4.3 Skeletal representation

The anatomical profile of the bone assemblage is characterized by the abundance of cranial and limb remains, followed by axial and foot elements (Fig. 6). The same trend is observed for the triad taxa. As far as possible, ribs and vertebrae were identified to the taxon, but a determination bias (underestimation) should be taken into account for this category. Indeed, when skeletal representation is viewed as a percentage of the total number of faunal remains (anatomically determined but not taxonomically determined), the foot is still rare but the axial category seems better represented. However, this can be explained by the high fragmentation of costal elements. In addition, this under-representation can be explained in part by the high impact of carnivores on bones (20% of the total assemblage shows signs of gnawing).

Fig. 6: a: Skeletal representation per main species in percentage of MAU (Minimal Animal Unit) of the faunal assemblage of La Motte I. b: Skeletal representation of all species taken together as a percentage of total faunal remains of La Motte I.

The analysis of skeletal representation reveals no major differences between domestic and wild species. The foot category for pigs is rare. The skeletal representation of deer shows that limb bones outweigh those of the skull and the foot category is well represented in comparison to the axial category. As deer are wild hunted animals, we can assume that the carcass would have been processed differently to domestic species. Taphonomic bias could play a major role in this particular skeletal distribution, as small parts may have been moved away by the river current. But this hypothesis is challenged by the presence of rabbit bones and rare sea bream jawbones. Underwater

284 excavation conditions can also generate biases and although the diving excavators were experienced,
285 it was complicated to take samples for sieving under these conditions. This could impact the
286 representativeness of very small fish remains, but this is not the case for mammalian remains.
287 Therefore, it is more likely that this particular skeletal representation is due to anthropogenic
288 selection, with limbs reflecting culinary waste and cranial remains being rejected after removing
289 edible parts (as evidenced by some anthropogenic marks at the junction of the jaws). The scarcity of
290 axial and appendicular parts of the skeleton could mean that inedible parts of the animal were
291 discarded elsewhere.

292 4.4 Mortality profiles

293 Mortality profiles were only calculated for teeth, taking into account the stage of wear and dental
294 eruption.

295

296 **Fig. 7:** Domestic triad culling profile, based on wear stages and dental eruption. Number of cattle teeth: upper=36, lower=56; caprine
 297 teeth: upper=74, lower=155; suids teeth: upper=19, lower=41.

298 4.4.1 Cattle

299 The combination of lower and upper teeth (N = 92) was used to calculate mortality profiles. AtD
 300 results reflect a strong slaughter peak between 1-2 years (Fig. 7) and subtle peaks at 0-1 months and
 301 2-4 years. This could reflect multiple practices: killing calves for tender meat, slaughtering prime
 302 adults for maximum meat yields and slaughtering retired lactating females and old males for herd

management (Gillis *et al.*, 2016). In this case, we cannot confidently identify dairy farming (Greenfield, 2005; Greenfield and Arnold, 2015; Helmer *et al.*, 2007; Payne, 1973).

4.4.2 Caprines

For sheep and goats, the culling profile peaks between 6 months and 1 year, followed by a slight peak at 1-2 years (N=229, Fig. 7). This depicts an emphasis on tender meat (Helmer and Vigne, 2004; Payne, 1973). However, traces of slaughtering of older adults are also visible in this histogram. Again, this implies that animals were culled post-lactation or for wool farming.

4.4.3 Suids

Young pigs (N=60) were slaughtered mainly between 10 and 12 months of age (Fig. 7). This may reflect a preference for tender, high-quality meat. Culling older pigs (aged 1 to 4 years) can be interpreted as a quest for maximum meat yields and the killing of pigs over 4 years of age can occur after fattening or at the end of reproductive functions.

The three mortality profiles correspond to a "tender meat" profile. The age limit for older cull animals (9 years for cattle, 6 years for caprines and 8 years for Suidae) may indicate their use for secondary production and herd birth-rate management, in order to always have a large number of young individuals available.

4.5 Taphonomic alterations

The underwater environment of the site caused specific polishing of the cortical surface of the bones. Almost all the remains are light brown to dark brown. The entire assemblage (1,321 faunal remains) was observed for taphonomic alterations. Most of the bones underwent superficial dissolution due to the fluvial context. Some of them present specific marks made by seaweed and small marine bivalves. Carnivores caused a number of changes in the bone surface as 20% of the total assemblage shows gnawing by carnivores. This indicates that culinary waste was accessible to commensal species and that landfill of the remains was slow. Burnt remains are easily distinguishable from natural

327 staining, as burn marks are black or grey/white while natural staining colours bones soft brown to
328 dark brown. The number of burnt remains is very low.

329 4.6 Anthropogenic marks

330 Cutting marks were identified on 10% of the 1,321 faunal remains and 17% of NISP (Fig.8) on all
331 mammalian species: *Bos taurus*, *Bos primigenius*, *Sus scrofa*, *Ovis aries*, *Capra hircus*, *Canis lupus*
332 *familiaris*, *Oryctolagus cuniculus*, *Equus caballus* and *Cervus elaphus*.

333

Fig 8 (in colour): Butchery marks on the skeletons of deer, cattle, pigs and caprines.

Five categories of anthropogenic cutting marks were observed on cortical bone surfaces. These highlight the stages of carcass processing such as disarticulation, removal of horns and feet, skinning and cutting meat, among others (Gardeisen, 1999). These observations demonstrate some slight differences between the consumed species. Indeed, butchery techniques vary with the size of the animal: for large mammals such as cattle and deer, large tools such as meat cleavers or saws are preferred, while knives are used for medium-sized mammals such as caprines or suids. Cut marks are mainly located on limbs (48%), or on the diaphysis just below the joint surface, suggesting disarticulation and meat removal (Lyman 1987, 1994; Soulier and Costamagno 2017). The only common butchery technique to all four species is observed on lumbar vertebrae (slicing or notching), indicating the separation of the hindquarters. For large mammals (cattle and deer), marks on the cervical vertebrae indicate dissociation of the head. Scratches on carpals and tarsals show disarticulation of the feet and possibly skinning. The deer is the only animal with a longitudinal cut mark on the scapula, probably to remove the meat. Most of the time, cattle and caprines had their horns and antlers cut off, probably for artisanal purposes, although there is no real evidence of this. This can also be interpreted as a phase of skinning. The disarticulation of the femur-tibia connection is observed for all animals except cattle, but the latter are only represented by one entire femur. This reveals that the hind legs were generally separated into two parts for consumption. The heads of cattle show different treatment compared to other species. Analysis of the cut marks plausibly demonstrates the removal of the tongue, jaws and muzzle. Ruminants present similarities such as the removal of the ligament of the scapula and humerus, probably in order to isolate the joints. The cutting of ribs and the removal of meat from ribs and thoracic vertebrae are present on all three taxa. Thin crossed scratches situated along the caudal rim of a caprine scapula seem to indicate on-site consumption.

A single scratch was observed on a rabbit coxal, suggesting the consumption of rabbit meat. The astragalus of *Bos primigenius* also shows cut marks and suggests that this animal was hunted. There

360 is no evidence of of horse meat consumption. However, a third phalanx presents some cut marks on
 361 the sole, which could indicate the recovery of the hoof, perhaps for artisanal purposes. Scratches
 362 were observed on a dog coxal and a dog mandible shows cortical removal at its base (Fig. 9).

363
 364 **Fig. 9:** Butchery marks (arrows) visible on bones from La Motte I. a: cortical ablation on canine mandibular base (*Canis lupus familiaris*),
 365 labial view. b: medial view of a sliced astragalus of an aurochs in connection with the cubo-navicular (*Bos primigenius*). c: Third phalanx of
 366 horse (*Equus caballus*) with medial cut mark (distal view).

367 368 5. Discussion

369 It is generally accepted that at the end of the Bronze Age, the notion of territorial concentration
 370 revolves around fortified settlements, which are potentially the seat of a local elite (Brun, 1988; Brun

371 and Pion, 1992; Pautreau, 1992). However, the present zooarchaeological study implies that the
372 lifestyle of the inhabitants on the Languedoc coast seemed quite similar to that of the elites. They ate
373 tender meat and herd management focused on producing young animals, as at the elite site of
374 Boulancourt (Seine-et-Marne, France). Indeed, the mass slaughter of young animals is not a long-
375 term solution for herd management and shows that the inhabitants of La Motte had a comfortable
376 way of life. This is also evidenced by the rich feminine bronze set recovered during the early
377 excavations of the lagoon site, attesting to the presence of a local elite. La Motte I therefore seems
378 to be a much more important site than previously thought, with a high standard of living and families
379 probably belonging to a local elite.

380 Unfortunately, faunal data from Late Bronze Age breeding sites are lacking in France (especially in
381 Languedoc), most often due to the scarcity of remains (less than 100 remains per site in general).
382 This makes it difficult to interpret mortality profiles, for example. The results from La Motte I could
383 be compared with those of lagoon sites around the Or Lagoon (Columeau, 1985) but no in-depth
384 faunal analyses are available for the latter. Age at death categories only include three groups in
385 Columeau's analysis: very young, young and adult individuals. According to his study, caprines and
386 pigs predominate in the young category, and cattle in the adult category as a percentage of MNIs.
387 However, these results should be considered with caution as there is no subadult class and no
388 explanation of the methods used for ageing. For other rural sites in northern France, some compiled
389 analyses (Auxiette, 1997) show an emphasis on pig farming, which is not the case here. But we
390 cannot deduce with certainty whether this is due to cultural, environmental or social differences.

391 The second point is that, despite the presence of the lagoon at the edge of the settlement site, fish
392 remains are rare on the site. This may be due to the lack of systematic sieving for very small fish
393 bones but some medium-sized fish remains were recovered, such as sea bream. Agropastoral
394 activities therefore seem to supply significant subsistence resources. Carpological and entomological
395 analyses (Bouby *et al.*, 2016) of the organic layers of the site backed up this general interpretation.

They revealed numerous carbonized seeds and leaf remains, as well as plant residues interpreted as animal litter and two species of insects (*Aglenus brunneus* and *Platytomus tibialis*), linked to livestock stalls and the accumulation of old manure. Meanwhile, fishing is evidenced by a bronze hook adapted to fishing for large predators. This suggests that large fish remains should have been recovered, but they have only been found in small quantities at La Motte I. It can therefore be assumed that the population fished at sea and ate shellfish, but that this was not the main activity of the settlement. La Motte I was not a fishery.

As far as large animal hunting practices are concerned, they do not appear to have been vital for subsistence, but were perhaps linked to proving the value and strength of hunters. Although only three aurochs remains have been recovered on the site so far, the height of the hunted animal implies that this was a difficult mission. It can be also assumed that it was killed for security reasons, as the exceptional size of the animal would have represented a danger for the community living there. As regards small game hunting, the scarcity of rabbit remains does not allow us to draw a definite conclusion. Only one coxal shows signs of meat removal. There are also some bird remains, but no anthropogenic marks have been observed on bird bones. In addition, the presence of the cormorant, which is a species living in the aquatic environment, may be coincidental here. All the hunted species could potentially live near the settlement: deer could be present in the nearby riparian forest and rabbits in the surrounding salt marshes. It can therefore be assumed that hunting was opportunistic.

6. Conclusion

The results of this zooarchaeological analysis depict a faunal spectrum dominated by the domestic triad (cattle, pigs and caprines), with significant hunting activity (deer and lagomorphs). Butchery activities are attested by bone remains presenting anthropogenic cut marks. This is supported by the trend in culling profiles highlighting a preference for quality and tender meat consumption. This type

of herd management requires a privileged social environment. Minor canine meat consumption is also noteworthy. Thus, although halieutic resources such as sea shells and fish were found on the site, it appears that the livelihood strategies of the Late Bronze Age population of La Motte I included animal husbandry and the consumption of a large amount of meat despite the proximity of the lagoon. The present faunal study shows a preference for the consumption of tender meat, while the presence of the female bronze set suggests that this lagoon settlement enjoyed privileged status. This indicates that - at least in some cases - lagoon sites could be important and influential areas and not merely satellite sites of fortified hilltop settlements.

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Appendices: Table A

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