Camels in Saudi oasis during the last two millennia; the examples of Dûmat al-Jandal (Al-Jawf Province) and al-Yamâma (Riyadh province)

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ABSTRACT
By its extraordinary adaptability to live in a hyper arid environment, the camel *(Camelus dromaderius)* is certainly the animal that best characterizes the Arabian Peninsula. If a rich ethnographic literature exists showing the economic importance of this species through the last two millennia, few archaeozoological remains confirm this importance. This article presents preliminary archaeozoological data (skeletal representation, ageing and sexing bone, bone traces) from two archaeological assemblages from Saudi Arabia: Dûmat al-Jandal (Al-Jawf oasis) and al-Yamâma (Al-Kharj oasis).

KEY WORDS
Zooarchaeology, skeletal profile, sexing and ageing camel bones, classical and medieval times, Saudi Arabia.

RÉSUMÉ
Les dromadaires dans l'oasis de Saudi Durant les deux derniers millénaires ; l'exemple de Dumat al-Jandal (province Al-Jawf) et al-Yamâma (province de Riyadh).
Par ses extraordinaires facultés d'adaptation à un mileu désertique hyper aride, le dromadaire *(Camelus dromaderius)* est certainement l'animal qui caractérise le mieux la péninsule arabique. Mais si une abondante littérature ethnographique existe montrant l'importance économique du dromadaire à travers ces deux derniers millénaires, rares sont les preuves archéozoologiques confirmant cette importance. Cet article présente des données archéozoologiques préliminaires (représentation squelettique, détermination de l'âge et du sexe, traces sur les ossements) de dromadaire provenant de deux assemblages osseux issus d'oasis saoudiennes, les sites de Dûmat al-Jandal (Al-Jawf region) et d'al-Yamâma (Al-Kharj oasis).

MOTS CLÉS
Archéozoologie, représentation squelettique, détermination de l'âge et du sexe, Antiquité tardive et Moyen Age, Arabie saoudite.

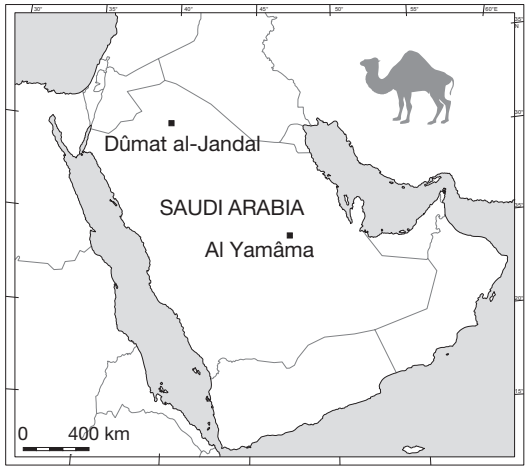

Fig. 1. – Dumât al-Jandal and al-Yamâma location in Saudi Arabia.

INTRODUCTION

By its anatomy, physiology, but also its ethology, the dromedary, the one-humped camel, is certainly the emblematic animal of the arid desert environment, especially in the Arabian Peninsula. Arabia is the likely place of the dromedary's earliest domestication, which most authorities date to the third millennium B.C. or earlier (e.g. Uerpmann & Uerpmann 2002; Sapi-Hen & Ben-Yosef 2013). The economic role of this animal is so visible for the population, especially for the Bedouins, that Arab poets have often called the camel the 'ship of the desert'[1]. The Bedouin use the camel for many purposes, including transport, meat, milk, and sometimes they also make use of their skins. But if an abundant (ethnographic) literature exists showing the economic value of the camel, zooarchaeological data on camel bones are rare. This is especially the case for classical and medieval times, contrary to the Bronze age or Iron age in the South of the Peninsula (e.g., Mashkour 1997; Driesch & Obermaier 2007; Beech *et al.* 2009). In addition, many studies were written on the camel's economic importance for the Middle Ages in the South Levant, but even if the camel was widely used in this region, bones are rather rare. This work therefore aims to present preliminary archaeozoological data on camel from two sites located in oases in Saudi Arabia: Dûmat al-Jandal and al-Yamâma.

1. Long ago, Saydah Dhû l-Rumma said that his she-camel was a safiinat al-barr or land ship. His poem stated «a land-ship whose reins beneath my cheek are passed.» (Dhu lRumma, Diwan, edited by Carlile Henry Hayes Macartney, Cambridge, 1919, page 638).

THE SITES: BACKGROUND

The site of Dûmat al-Jandal (al-Jawf region)

Due to its location on the borders of the Wadi al-Sirhan linking southern Syria to the Saudi desert, the oasis of Dûmat al-Jandal (or Dûma) is one of the few stopping points required between the East and West of the Arabian Peninsula (Fig. 1). The data presented in this paper are the results of analyses conducted on a zooarchaeological assemblage recovered during the joint Saudi-Italian-French excavations, which took place from 2009 to 2011 (Charloux & Loreto 2013, 2014; Loreto & Charloux 2013). The bone material comes from area A, the historic urban-area just near the Qasr Marid. Several phases of Islamic occupation (Late Islamic, 15th-18th cent. AD, Middle Islamic. 8th-15th cent. AD and Early Islamic, 7th cent. AD) were identified as well as a late pre-Islamic phase related to a massive structure (Building A). The construction techniques and the pottery items found within it, allow us to say that this building was related to a pre-Islamic building (late Nabataean/Roman-Byzantine) (Loreto 2012).

The site of al-Yamâma (al-Kharj oasis)

The area of al-Kharj is located in the eastern part of the Najd in East-Central Saudi Arabia (Fig. 1). Within this oasis, the largest archaeological site is called al-Yamâma (Schiettecatte *et al.* 2013). The archaeological area stretches over 75 ha and many mudbrick structures are exposed on the surface, together with a large quantity of pottery sherds. The faunal remains come from two archaeological contexts: Sounding 1 (accumulation of waste deposits in open-air area) and Sounding 2 (dwelling). In these soundings, four chronological phases of occupation have been isolated: phase 1 (15th-18th centuries AD); phase 2 (Abbasid period: 8th-12th

TABLE 1. – Location and stratigraphic context of al-Yamâma excavations.

Location	Phase	Stratigraphic units (UF)
1	**Phase 1 - Late Modern**	
1.1	Surface deposit or aeolian accumulation post-abandonment immediately beneath the surface	001; 002; 007; 022; 035; 050; 100
1.2	Building 1: Mosque - pits recovery after the mosque abandon or filling pits, generally recovery bricks in the walls of the mosque	024 (W.006); 025 (mihrab); 028 (W.006)
2	**Phase 1 - Modern**	
2.1s	Building 2: Sounding 2: domestic house	101 (abandon/collapse); 102 (occupation); 103 (occupation)
2.2	Sounding 1: refuses along the north wall W.001	003; 008
2.3	**Sounding 1: north part of the mosque: between the long wall W. 001 and the wall W. 003**	
2.31	Group 1: refuse in late Aeolian accumulation or in collapse of W. 003 probably contemporary of the lastest squat levels of the mosque	004; 005; 010; 032; 039
2.32	Group 2: circulation/ accumulation north of the mosque when in use	015; 017; 041
2.33	Group 3: interface Phase I and phase II, apparently prior to the mosque	020
2.4	**Sounding 1: west part of the mosque (west of W. 006)**	
2.41	Group 1: refuse in late aeolian accumulation probably contemporary with the latest squatter occupation levels of the mosque	029; 031
2.42	Group 2: circulation/accumulation on the west part of the mosque when it is in use	033; 044; 045; 046; 048
2.5	**Building 1: Mosque (prayer room)**	
2.51	Group 1: late reoccupation of the mosque	023; 026; 027; 034; 036; 037; 043
2.52	Group 2: occupation of the mosque	030
2.53	Building 1: courtyard of the mosque	038
3	**Phase 2 - Late pre-Islamic/Early Islamic period**	012; 018; 021; 051; 052; 053; 054; 055
4	**Phase 3 - Early Islamic period**	056; 057
5	**Phase 4 - Pre-Islamic-period**	058; 059; 060; 061

cent. AD); phase 3 (provisionally dated to the Late pre-Islamic/Early Islamic period: 4th-7th cent. AD); phase 4 (ca. 3rd cent. BC-3rd cent. AD) (Table 1, Schiettecatte & Al-Ghazzi in press). Sounding 1 was carried out along the slope of the mound, North-East of the site. It is a 25-m-long trench, oriented North-South, 7 m wide and 7 m deep. It was set next to a large columned hall (a mosque), over the thickest accumulation of archaeological deposits. Situated within a mudbrick house, the sounding 2 straddles two rooms devoted to cooking and domestic activities. The discovery of many burnt bones associated with an oven (*tannūr*) highlighted the alimentary habits of the last occupation phase on the site. Generally, the bones came from three types of contexts: (1) Human circulation / occupation levels (floors, pathways and fire places) substantially in the mosque or around it; (2) Sedimentary (sandy) aeolian filling (dump areas): bones (carcasses) have been abandoned or thrown away along some walls, away from the pathway; (3) the collapse of mud-brick structures (Monchot in press a).

METHODOLOGY

The quantification of the camel remains is based on the total number of identified specimens (NISP), on the minimum number of Individuals (MNI) and on the minimum number of elements (MNE). The

TABLE 2. – Species list number of identified Specimens (NISP) from Dûmat al-Jandal in (2009-2011 excavations) and al-Yamâma (2011-2012 excavations) (%NISP only for the identifiable element; MNI= minimum number of individuals).

SECTOR	Dûmat			Al-Yamâma				
	A			S1	S2	TOT		
	NISP	%	MNI	NISP	NISP	NISP	%	MNI
Herbivora								
Camel *(Camelus dromedarius)*	2071	70.3	47	984	153	1137	47.2	27
Sheep/Goat *(Ovis aries/Capra hircus)*	763	25.9	50	811	88	899	37.3	30
Gazelle *(Gazella* sp.*)*	43	1.5	10	69	26	95	3.9	12
Oryx *(Oryx leucoryx)*	5	0.2	3	1		1	<0.1	1
Cattle (*Bos taurus*)	7	0.3	4	12		12	0.5	2
Bovid	3	0.1	–	39		39	1.6	–
Equid *(Equus* sp.*)*	27	0.9	7	11	1	12	0.5	4
Carnivora								
Dog (*Canis lupus* cf. *familiaris)*	14	0.5	5	40	7	45	1.8	5
Fox *(Vulpes* sp.*)*				4		4	0.2	3
Cat *(Felis catus)*				4		4	0.2	2
Honey badger *(Mellivora capensis)*				1	1	2	0.1	2
Birds								
Chicken *(Gallus gallus)*	2	<0.1	2	2	2	4	0.2	2
Ostrich *(Struthio camelus)*	3	0.1	–	2	1	3	0.1	–
Spotted sandgrouse *(Pterocles senegallus)*					1	1	<0.1	1
Common buzzard *(Buteo buteo)*	1	<0.1	1					
Eagle *(Aquila sp.)*	1	<0.1	1					
Bird indet.	4	0.1	–	2	1	3	0.1	–
Insectivora								
Desert hedgehog *(Paraechinus aethiopicus)*				1		1	<0.1	1
Rodent indet.	1	<0.1	1					
Reptilia								
Spiny-tailed lizard *(Uromastyx aegyptia)*				127	18	145	6.0	17
Molluscs	1	<0.1	–	4	–	4	0.2	–
Small mammal	56	–	–	222	54	276	–	–
Medium mammal	111	–	–	70	11	81	–	–
Large mammal	95	–	–	242	29	271	–	–
Unidentified	1615	–	–	4366	213	4579	–	–
Total	**4823**	**100**	**131**	**7014**	**606**	**7618**	**100**	**109**

MNI is defined as "the smallest number of individual animals needed to account for the specimens of a taxon found in location" (Ringrose 1993). The MNE is an estimate of the skeletal abundance, that is, the minimum number of skeletal parts or portions necessary to account for the specimens under study (Lyman 2008: 218). All of the measurement and abbreviations are used according to Driesch's standard (von den Driesch 1976). To estimate the age at death, two main methods were utilized. The first is by estimating the stage of tooth eruption and analyzing dental wear (Lesbre 1903). The second method based on bone fusion is less reliable as a result of the various taphonomic processes affecting the skeletal remains, especially those of young immature individuals and those bones with a high marrow and spongiosa content. As no age data for the development of the postcranial skeleton in camels are available in the literature, we have used the data for slowly maturing from the 19th and early

20th century cattle breeds (von den Driesch & Obermaier 2007: Tab. 6).

RESULTS: THE CAMEL BONE ASSEMBLAGE

Dûmat al-Jandal

The excavations carried out at Dûmat al-Jandal in the sector A yielded a largest sample of 4823 faunal remains from which one finds 2071 camel bone elements (42.9%, but 70.3 % of the identifiable bones) spread over several archaeological layers. In number of elements the camel largely dominates the bone assemblage and comes before before caprine remains; the others species are more marginal (e.g., gazelle, donkey, dog and oryx, Monchot in press b, Table 2). The occurrence of camel bones in all the stratigraphic units is not surprising given the localized oasis environment in an otherwise desert region. The results presented in table 2 belong in large parts to the upper levels 1 to 4, which represent a large waste area dated to the Late Islamic (15th-18th century AD) and Middle Islamic (8th-15 century AD) periods (see Monchot in press b for more details).

Table 3 and Figure 2 present the skeletal profile for the levels where the camel is most abundant. Although all skeletal elements are represented, we observe a deficit in short bones (i.e., carpals or phalanx) and teeth, which are poorly preserved. The slight over-representation of vertebrae and some long bones is understandable given the intense fragmentation of these elements (i.e. several specimens can belong to the same element). The camel bones, especially those belonging to levels close to the surface have undergone an intense weathering, which exploded teeth, destroyed the long bone shafts into fragments, and created many splinters. This bone fragmentation was enhanced by the methods used during the excavation. No sieving was done in area A and faunal material was mainly hand-collected. This intense fragmentation associated with a complex stratigraphy does not allow for a reliable calculation of NME.

Nevertheless an estimated minimum number, based mainly on the talus/distal humerus, of 47 individuals was identified. Adult individuals and some juveniles can be identified from the unfused epiphyses of long bones. For instance in level 2, the juvenile was aged less than one year (second phalanx unfused). In level 3, the juvenile was aged less than one and half years (first phalanx unfused). In level 4, two individuals were aged less than 3 and half years and 4 years, respectively. In level 7, the juvenile was three and a half years old (calcaneus proximal unfused). Lastly, the two juveniles from the building 6 were less than two years old (maxillary with milk tooth and unfused tibia). According to the tooth wear stages, the old individuals were aged more than 6-8 years old. Camels reach sexual maturity around 4 years of age. No yearling individuals were revealed in the bone assemblage.

The presence of feet and cranial elements, considered as non-dietary butchery portions, confirm the idea that we are not in a butchery area. Instead, this suggests that excavations are likely occurring in a former refuse or midden location. According to the modified general utility index or MGUI (Lyman 1994), the parts of the skeleton with a low utility index, such as feet and skull, may be abandoned at primary butchering areas. Conversely, meaty parts, such as the pelvis and limbs, are more likely to be transported from the butchering site and deposited closer to the site where secondary processing and consumption occurred.

Sexing camel bone

In many mammalian species, some skeletal parts differ in morphology between the sexes. In bovids for instance, female skulls either lack horns or bear horns of different size and shape relative to those of males (Boessneck *et al.* 1964; Grigson 1882). Unfortunately for sex-determining efforts, these parts are relatively fragile and are therefore rare in archaeological assemblages due to the selective removal by post-depositional leaching, profile compaction, and other fragmentation processes. As an alternative to differences in bone shape, it may be possible in some samples to use differences in bone size to establish a sex ratio. Male skeletal parts tend to be larger than female homologues in most mammal species, reflecting larger average male body size. One clear advantage of this

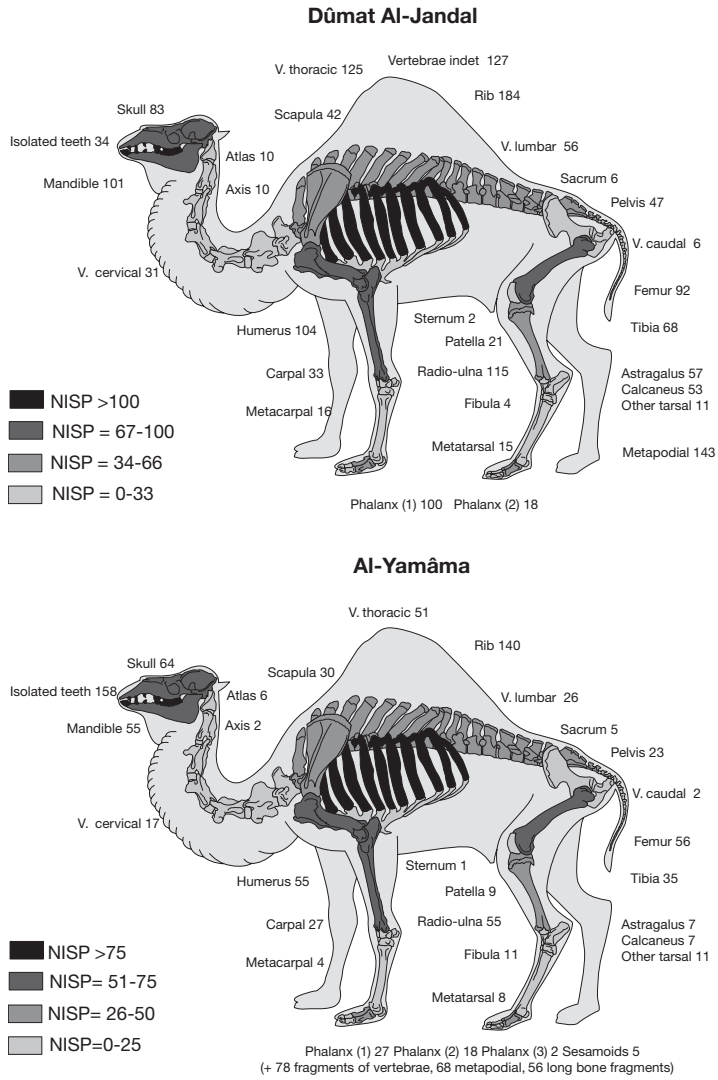

FIG. 2. – Skeletal profile of the camel from Dûmat al-Jandal and al-Yamâma based on Number of Identified Specimens (Drawing Michel Coutureau, available in http:www.archeozoo.org).

criterion is that it is applicable to a wide variety of skeletal parts, at least some of which are likely to occur in any large fossil sample. Therefore, according to the Rensch'rule (Rensch 1950), which shows that larger mammals tend to exhibit greater sexual dimorphism, a preliminary estimation of the sex ratio was made from the talus measurements. We compared the data acquired at Al Sufouh 2 site (Driesch & Obermaier 2007) and the data published by Steiger (1990). The talus results (Fig. 3) show a predominance of female/juvenile individuals as demonstrated by the relatively smaller size observed on the other bones (e.g., radius, tibia). It is worth pointing out that the age and sex distribution is not necessarily that of the original herds, but rather of those individuals that were selected as prey and whose bones were left at the site.

TABLE 3. – Quantification of camel remains at Dûmat al-Jandal (sector A, trenches 1 & 2) expressed in NISP (number of identified specimens) according to the different stratigraphic levels (Loreto, in press: Tab. 1; **LI**, Late Islamic; **MI**, Middle Islamic; **EI**, Early Islamic; **LN**, Late Nabatean ; **EN**, Early Nabatean)

Levels	MI 2	MI 2b	MI 3a	MI 3b	MI 4	MI 14	MI M19	EI 6	EI 7	EI 12	EI 13	EI M31	LN 5	LN 9	EN 10	LI 1	LI 4	Varia --
Skull	3	6	7	4	3	2	2		6	1	5	1		1	1	1	4	
Maxillary	7	5	7	10	1	2	3										1	
Mandible	11	4	35	13	8	3	3	3	4	1	3		1		3	7		2
Isolated teeth	1	2	7	11	1	2			2						1	1	5	1
Atlas	2		3	1		1	2										1	
Axis	2		2			1	1								3		1	
Cervical vertebra	9	4	1	2	3	3	1			1		1		1	2	1	1	1
Thoracic vertebra	33	5	30	16	10	3	8	5	1	2		1		2		5	3	1
Lumbar vertebra	16	4	13	5	7	1		2	1	1		1		2		2		1
Caudal vertebra			3	2														1
Vertebra indet.	21	2	37	27	4	6	13	1	1			5		3		4		3
Sacrum		1		2		2									1			
Sternum	1															1		
Rib vertebral ext.	16	2	8	6	1	4		1			1					2		1
Rib shaft	29	9	13	32	3		16	2	3	2	3	6		1	3	1	5	6
Rib sternal ext.	1	3			1		1										1	1
Scapula	11	1	6	7	2	1			1		1	1			2	8	1	
Humerus prox.	11		7	5	1	2		1				1				2		1
Humerus dia.	5	2	2	2					1									
Humerus dist.	13	2	21	8	6		4					3			2		1	1
Radius prox.	11	1	12	3	2	2	3		1						1		1	
Radius dia.	6	1	1	1	2		2											
Radius dist.	10		8	4	5		2		1	1		2				1		1
Ulna	9		8	4		1	3		1	1	2						1	
Carpal	9	1	3	5			3	2	3	1	1	1		1	1		1	1
Metacarpal prox.	5		4	3			3										1	
Pelvis	12	4	11	4	1	1	6			1	2	1			1	1	1	1
Femur prox.	11	1	6	7	2				1			1	1		1	1		
Femur dia.	4		2	1														
Femur dist.	3		13	11	4	3	4		1		2		2	3		3	1	3
Patella	5		7	3	2		2			1				1				
Tibia prox.	6	1	5	1	3		4		1			3	1			1	1	
Tibia dia.	1		1				2	1				1						
Tibia dist.	9	2	6	3	2	1	6			2		1					2	1
Fibula (malleolus)			1						1							1		1
Astragalus	13	3	15	8	7		6							1	1	2	1	
Calcaneus	11		20	6	4	1	4		2			2	1		1		1	
Other tarsal	2	1	2	3				1	1	1								
Metatarsal prox.	1		1	1	5				1			1			2		3	
Metapodial prox.	9	1	3	7	1	1				1								
Metapodial dia.	4		7	6	5		1	2			1	1					1	1
Metapodial dist.	17	6	29	8	6		8	1	5	1					3	2		5
Phalanx 1	23	1	19	8	9	5	9	4	1	3	3	4		1	2	3	3	2
Phalanx 2	4	1	3	5	1		2									2		
Long bone (shaft)	27	15	15	25			23	4	1	7		5		2		2	16	4
Spongiosa	6		8	1	5	13	23	3		6	13	5				5		
Indeterminate	26	1	4	56	1		23									9		3
Total	436	92	416	337	118	61	193	33	41	34	37	48	6	19	31	68	58	43
MNI Camel	7	3	10	5	4	1	4	1	1	2	1	2	1	1	1	2	1	--
NR total	932	151	1147	663	153	133	392	77	113	99	214	121	8	32	147	141	165	131
% Camel	46.8	60.9	36.3	50.8	77.1	45.9	49.2	42.8	36.3	34.3	17.3	39.7	75.0	57.6	21.1	48.2	35.1	32.8
% Caprine	11.5	33.8	13.1	23.7	13.1	15.8	9.4	10.4	15.3	12.1	36.0	14.9	25.0	12.5	14.3	19.1	10.9	11.4

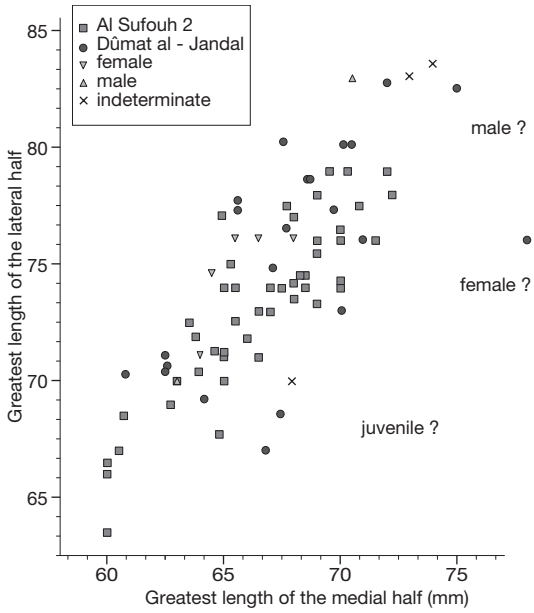

Fig. 3. – Diagram of the greatest length of the lateral half and the greatest length of the medial half (in mm) of the camel talus of Dûmat al-Jandal.

Bone surface modifications

Thirty camel bones (6 rib, 4 talus, a tibia, 2 femur, 5 lumbar vertebra, a skull, 2 mandible, a radius, a metapodial, a phalanx 2, a humerus, a pelvis, a thoracic vertebra, a calcaneus, a fragment of indeterminate vertebra and one indeterminate fragment) show cutting or butchering marks. Disarticulation incisions and filleting incisions, both resulting from cutting using a knife, are present. Intentional fragmentation of the diaphysis and sectioning of long bones with a chopping implement like a cleaver are also observed. The variety of butchery marks proves that the inhabitants of the urban center of Dûmat consumed camel. This is not an unexpected result since the faunal remains represent consumption debris recovered from a domestic district of the site.

Evidence of burning was exhibited on 54 camel bones, especially on vertebra, mandible or femur. A large majority (75.9 %) of these burnt bones belong to the superior levels, a large dump area dated to the late Islamic period. In most cases, the heat was not sufficient to completely charr the bone. The examination of the colour and the macroscopic appearance of bones show that the vast majority of these bones are brown/black, belonging to burned colour stages 2, 3 and 4 (Périnet 1964; Stiner *et al.* 1995). It is reasonable to think that the reduction by the fire results directly from human activities, cooking, roasting and preparation of food, with certainly the presence of hearths not far from the deposits, but it can also be the result of other intentions like accidents or the cleaning of garbage by fire.

Three second phalanges from level 3b show clearly marks of exostosis. This bone inflammation can be divided into three types (osteoperiostitis, osteomyelitis, and osteitis), but is often difficult to determine which type is present when dealing with archaeological material (Baker 1984). This is proof that camels, in addition to being consumed, were used as beasts of burden. However, as cattle examples show, this pathology can also develop over time and can be prevalent in older individuals (De Cupere 2001; Studer 2010).

al-Yamâma

Unsurprisingly camel and caprine are by means of NISP the best species represented in al-Yamâma (N=1137, Monchot *et al.* 2014, Table 2). As for Dûmat, all skeletal parts were identified (i.e., head, trunk, forelimb, hindlimb and extremities). The skeletal distribution according to the different stratigraphic phases of the site is presented in Table 4 and Figure 2. However, this figure needs some further explanation: (1) No complete long bones have been found. They also suffered intense weathering, producing many splinters. All parts of the long bones were recognized in the assemblage, but it is difficult to clearly identify the origin of this fragmentation: a natural origin (trampling, weathering etc.) or if it is directly the result of human activities like cutting carcasses into quarters, marrow extraction, or a bone reduction for cooking or roasting, or a mix of these two origins; (2) Complete or sub-complete vertebrae are rare and the fragmentation of these bone (i.e., body, *processus spinosus*, *processus articularis*) increases the NISP; (3) Ribs are also very fragmented increasing too the NISP: 40 vertebral articular end fragments, 100 shaft fragments and 4 sternal end fragments; (4) The small bones, i.e. carpals, phalanges, tarsals,

TABLE 4. – Quantification of camel remains at al-Yamâma expressed in NISP (number of identified specimens) according to the different stratigraphic phases (Monchot, in press b; Table1: Phase 2, modern period; Phase 3, Middle Islamic period; Phase 4, Early Islamic period; Phase 5, pre-Islamic period).

Phase	**P1**	**P1**	**P1**	**P1**	**P1**	**P1**	**P1**	**P2**	**P3**	**P4**
Site location	**2.1**	**2.2**	**2.31**	**2.32**	**2.33**	**2.42**	**2.51**	**3**	**4**	**5**
Skull	13	6	8	2		1	1	11	15	
Mandible	7	10	10	2		2	7	12		
Isolated teeth	27	4	9	8			1	27	7	1
Enamel fragment			4	1	7			48	10	3
Atlas		1	1	1				1		
Axis		1							1	
Other Cervical vert.	2	1	5	3				2		
Thoracic vertebra	2	16	7	2		3	1	10	1	
Lumbar vertebra	7	3	4	3	1	1	2	2	2	
Caudal vertebra	2								2	
Vertebra indet.	17	6	2	4	1	4	2	22	4	
Sacrum			1		1			1		
Sternum		1								
Rib	20	21	18	8	2	8	7	37	8	1
Scapula	7	4	9	1		1	2	1	1	
Humerus	2	13	7	2	1		2	18	4	
Radius	3	9	5				1	16	4	
Ulna	1	2	1	1				3	2	1
Carpal		8	3	4	6	1		3	1	1
Metacarpal							2			1
Pelvis	1	3	1			2	2	13	1	
Femur	3	11	5	2	3	1	1	23	1	
Patella	2	2				1	1	1	1	1
Tibia	2	6	5	3		4	4	9	1	
Fibula (malleolus)	1	2	3	2				2		
Astragalus			1				1	2		
Calcaneus	2	1	1	1			1			
Other tarsal		1	5	1				3		1
Metatarsal	1	2		1				3	1	
Metapodial	9	10	13	2	5	4	7	9	4	
Phalanx 1	5	4	4	5			2	5	1	
Phalanx 2	4	4	1	2				3	1	
Phalanx 3		1						1		
Sesamoids	1			2	1				1	
Long bone (shaft)		8				2	12	19		
Long bone (epiphysis)			2	5		1	2	1		
Total	147	161	135	68	28	36	61	308	74	10
MNI	5	4	3	1	1	2	2	5	3	1

sesamoids and caudal vertebrae are generally underrepresented.

Then according to the stratigraphy we can estimate a minimum number of individual of 27. If all the skeletal elements were identified on the site suggesting that people brought the whole individual, it is still unclear whether these remains represent whole carcasses scattered under the influence of taphonomic conditions or whether they represent portions of skeletons discarded or a mixture of both.

AGEING CAMEL BONE

The age distribution according to the epiphyseal fusion status of long bones, phalanges, calcaneus or vertebrae (i.e. unfused bones) gave a minimum of 21 "juvenile" individuals which are distributed throughout the stratigraphy (Table 5). All other individuals present in the assemblage with fused epiphyses were more than 4 years, i.e, adult.

The determination of the age distribution based on teeth was less satisfactory. The poor preserva-

TABLE 5. – Camel age distribution according to the stage of epiphyseal fusion at al-Yamâma (after von den Driesch & Obermaier 2007: Tab. 6).

Skeletal part	NISP	Ca. age	UF location
Proximal humerus	4	< 4 years	003 (3); 023
Distal humerus	1	< 1.5 years	010
Distal radius	3	< 4 years	003 (2); 004; 055
Vertebrae	22	> 4 years	003 (4); 004; 012 (3); 022 (4); 031; 033(2); 041 (2); 051; 101 (3); 102
Proximal femur	6	< 3.5 years	003 (5); 015
Distal femur	2	< 4 years	022 (2)
Proximal tibia	7	< 4 years	004; 022; 033 (2); 034; 050
Distal tibia	2	< 2 years	003; 005
Distal metapodial		< 2.5 years	003 (3); 004 (2); 008; 010; 020; 031; 055 (2); 102 (2);
Calcaneus	2		003; 102
Phalanx 1	5	< 1.5 years	003; 010; 017; 102 (2)
Phalanx 2	2	< 1.5 years	015; 102
Metaphysis indet.	3	--	010 (2); 033

tion of upper and lower teeth makes it difficult to estimate the age of the slaughtered camel. As seen in the desert environment the teeth preservation is bad, showing evidence of cracking and splitting of enamel (Andrews & Whybrow 2005). Although the number of isolated teeth may seem high (n=158), they are mainly represented by 67 enamel fragments. The rest of the teeth elements are composed of 30 incisors/canines, 14 lower teeth, 20 upper teeth and 27 fragments of unidentified molars. Two milk teeth were found in the assemblage, a lower D4 in UF 052 and an upper D3 in UF 055 and belong to individuals aged 2-3 years. On the other hand in UF 003, 004, 057, 101, 102, several very abraded teeth belonging to older individuals aged to 6 years and more were identified (Lesbre 1903).

The predominance of young adult camels corresponds well to an age profile expected for pack animals. According to Horwitz and Rosen (2005), three different camel management strategies based on male-female ratio and age profile – one for milk, a second for meat and a third for transport/draught could be expected. Furthermore, they noted that camel herd composition is expected to differ between an urban site, a camel caravan and herds kept by nomadic camel herders.

BONE SURFACE MODIFICATION

Camel consumption is attested by the presence on bone of traces of burning, of fine cut marks made by a knife which reflects skinning (S), dismemberment (D), or filleting (F) activities and by the presence of chop marks (especially on vertebra) made by a cleaver which underline primary butchery of the carcass (for a description and interpretation of anthropogenic marks *see* Binford 1981; Fisher 1995; Monchot 1996):

– 32 bones present burning traces: pelvis in UF 018; 2 distal femur in UF 052; proximal femur in UF 053; distal humerus in UF 003; proximal humerus in UF 041; fibula in UF 102; a mandible in UF 008; proximal radius in UF 102; 4 ribs in UF 001, 028, 102; a skull (maxilla) in UF 102; 2 teeth in IF 017, 102; 4 thoracic vertebra in UF 003, 032; distal tibia in UF 022; 3 proximal tibia in UF 052, 102; ulna in UF 102; 4 body of vertebra in UF 003,102; 3 epiphysis fragments of long bone in UF 017, 023.

– 20 bones present cut marks: pisiform in UF 020 (D); scaphoid in UF 012 (D); 5 ribs in UF 003, 008, 012, 033, 102 (F); 2 lumbar vertebrae in UF 010, 102 (F); phalanx 1 in UF 004 (S); 2 phalanx 2 UF 001, 102 (S); thoracic vertebra in UF 018 (F); distal radius in UF 102 (D); 2 calcaneus in UF 017, 102(D); os tarsale IV in UF 061 (D); distal tibia in UF 012(D); 2 body of vertebra in UF 003, 102.

– 22 bones present chop marks: 2 pelvis in UF 053, 056 (D/F); 4 distal humerus in UF 032, 051, 056 (D); 3 proximal humerus in UF 003, 032, 102 (D); lumbar vertebra in UF 038 (D); 2 thoracic vertebrae in UF 051, 102 (F); phalanx 1 in UF 053 (S);

3 phalanx 2 in UF 010, 102 (S); sacrum in UF 012 (D); radius distal in UF 012 (D); radius proximal in UF 012 (D); talus in UF 022(D); tibia proximal in UF 003 (D); proximal femur in UF 002 (D).

Theses elements are found everywhere on the site in different UF, especially (N=25) in the ashy layer near the oven in sounding 2 (UF 102, R108). These traces were located throughout the skeleton suggesting a complete treatment of carcasses on the site.

CONCLUSIONS

Camels make up a significant proportion of the Dûmat al-Jandal and al-Yamâma bone assemblages throughout the excavated sequences and the zooarchaeological results clearly show a subsistence economy largely based on this animal. Camel is a purveyor of meat, milk and wool, but it would be simplistic to reduce this species only for the human diet (Studer & Schneider 2008). Camel, one of the symbols of the Bedouin life, served as transportation during many trips into the desert from oasis to oasis. The several uses of the camel are thus a dietary element, a beast of burden, a source of raw material for artifact manufacture and a cultural symbol.

These results are comparable to the ethnographic description of Bedouin life in recent decades in the desert of Saudi Arabia and are very encouraging for the future. Indeed the continuation of these excavations should allow us to better understand the lifestyle and alimentary behavior of the oasis inhabitants of Dûma and al-Yamâma and its evolution over the last two millennia.

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