The camel remains from site HD-6 (Ra's al-Hadd, Sultanate of Oman): an opportunity for a critical review of dromedary findings in eastern Arabia

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ABSTRACT
Bone remains of camel (*Camelus dromedarius*) have been found in several sites of south-eastern Arabia, dating from the Late Holocene period to the Bronze Age, and generally attributed to wild animals. The new camel finds from the Early Bronze Age site of Ra's al-Hadd (HD-6) – dated with radiocarbon technique between 2890-2580 BC – are the oldest camel evidence in the Sultanate of Oman. This discovery represents an opportunity for a critical review of all available data in the Arabian Peninsula. These remains are important because widen our knowledge about camel spreading trajectory and raise an obvious question about its domestication or wild status. This study contributes to the debate about camel status and the relationship between late prehistoric communities and this animal.

KEY WORDS
Camel,
domestication,
Bronze Age,
Sultanate of Oman.

RÉSUMÉ

Les restes de chameaux du site de HD-6 (Ra's al-Hadd, Sultanat d'Oman): une occasion pour une révision critique des découvertes de dromadaire en Arabie orientale. Des vestiges osseux de chameau (*Camelus dromedarius*) ont été trouvés dans plusieurs sites du Sud-est de l'Arabie, datant de la fin du Holocène à l'Âge du Bronze, et généralement attribués à des animaux sauvages. Les nouvelles découvertes de chameau provenant du site du Bronze ancien de Ra's al-Hadd (HD-6), datées grâce à la technique du radiocarbone vers 2890-2580 BC, sont les preuves les plus anciennes de chameau dans le Sultanat d'Oman. Cette découverte représente une opportunité pour une étude critique de toutes les données disponibles dans la Péninsule Arabique. Ces vestiges sont importants parce qu'ils élargissent nos connaissances sur la propagation de la trajectoire du chameau et qu'ils soulèvent une question évidente sur sa domestication ou sur son statut sauvage. Cette étude voudrait contribuer au débat sur l'état de chameau et sur la relation entre cet animal et les communautés préhistoriques plus tardives.

MOTS CLÉS
Chameau, domestication, Âge du Bronze, Sultanat d'Oman.

Rarely, a lone item recovered from the context of an archaeological excavation may bear a direct significance to broader historical questions in their regional perspective. Animal bones are no exception, particularly if the questions raised may refer to the transitional pathways of domestication of a species deeply involved with the evolutionary upheavals of human society.

The species we are referring to is the dromedary of Arabian ancestry (*Camelus dromedarius*), while the problem in question is the state of man-camel relationships in the final Formative phase of the Magan Civilization in Oman, between 3500 BC to 2500 BC (Cleuziou & Tosi 2007).

Up to now, the earliest remains of *Camelus dromedarius* associated with human occupation have been reported from the shell midden complex of Sihi, on the Red Sea coast of south-western Arabia (Grigson, Gowlett & Zarins 1989). The camel remains from Sihi comprise 8 fragments of camel bone, 41 fragments of bone of camel size and 7 unidentified fragments. The only available radiocarbon date (7200-7100 cal. BC) is from a jaw-bone[1], but it could be only confirming the presence of wild specimens of the beginning in the Early Holocene.

Several sites in south-eastern Arabia, datable from the Early Holocene period to the Bronze Age, have produced remains generally attributed to wild animals as human hunting products (Uerpmann & Uerpmann 2002). Among the oldest we have at least 40 individuals discovered from Baynunah, a site located in Abu Dhabi's Western Region (Fig. 1), recently dated from the second half of the 5th millennium BC by AMS (Beech, Mashkour, Huels & Zazzo 2009). The osteological dromedary elements are not associated with stone tools and the absence of cut-marks on them do not allow to interpret this site as a kill-off site; however, the results of studies made testify the diffusion of the wild dromedary into the desert area of the Western Region of the United Arab Emirates and the use of the animal for the high protein and fluid contents of its flesh (Beech, Mashkour, Huels & Zazzo 2009: 27).

During the Late Stone Age, evidence of wild dromedaries on the Arabian Peninsula emerged from al-Buhais 18 which seems to suggest a seasonal occupation by nomadic groups with a subsistence pattern based, above all, on raising domestic species (Uerpmann & Uerpmann 2002). However, the few dromedary finds would seem to indicate that the animal was hunted, given that domestication evidence has been considered successive (Uerpmann & Uerpmann 2000, 2008b; Uerpmann, Uerpmann & Jasim 2000). The camel fragments are 45 in total. The most indicative camel finds from al-Buhais site, a diastema fragment of a left mandible, belong to the Late Stone Age context (5100-4700 cal. BC).

1. The date could not be replicated in a second attempt at the Oxford AMS laboratory (Uerpmann & Uerpmann 2002: 236).

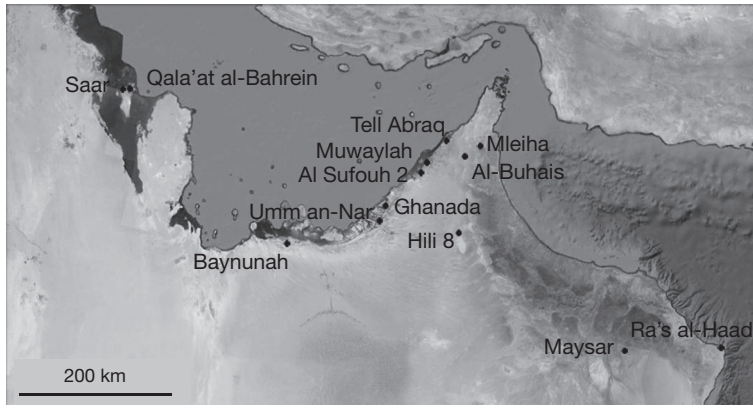

Fig. 1. — The Late Stone Age, Bronze and Iron Age sites with camel remains in eastern Arabia mentioned in the text.

Therefore, there is no evidence for a continuous existence of a wild camel population in eastern Arabia between the Upper Pleistocene and the camel domestication period (Uerpmann 1987).

The first data gathered from retrievals in the Abu Dhabi area came from the Umm an-Nar site in the UAE (Hoch 1979). The site dates back to the Early Bronze Age and certifies the presence of dromedary of Arabic descent and allows us to speculate on their relationship with human communities. The many camel remains found by the Danish Expedition (about 200 bones and teeth fragments) combining with representations of the animal carved on the stone slabs of a grave were interpreted by Hoch as direct evidence of domestication, highlighting an accomplished relationship between humans and camels. Several authors have since speculated that camels may have been used since the beginning of the 3rd millennium BC for carrying goods between the Gulf shores of Abu Dhabi and the oases along the Hajjar Mountains, most notably copper mined in the Wady Jizzi crossing the western desert of the Oman Peninsula. The Uerpmanns (2002: 238) have largely rejected this scenario for several reasons: among others, they question the assumption that a large number of bone remains imply animal domestication; domesticated mammals are usually rare in these contexts, contrary to terrestrial and marine wild fauna that are, instead, the majority. Thus, in their opinion, the exploitation of wild camels along with other wild ungulates (*Oryx leucoryx*, *Gazella subgutturosa marica*) seems more likely than their taming and domestication (Uerpmann & Uerpmann 2002, 2003). In support of this hypothesis they take into consideration the bas-relief of a dromedary from one of the collective graves of Umm an-Nar that doesn't contain any elements that could suggest its domestication, while the contemporary Hili grave depicts a donkey-like figure that has a rider (Uerpmann & Uerpmann 2012: 81-82).

Further evidence has been retrieved in the sites of Ra's Ghanada (a second neck vertebra), Hili 8 (a large mandible fragment, a small proximal scrap of a metatarsal bone and two fragments of first posterior phalanxes), Tell Abraq (UAE) and Maysar in the Sultanate of Oman (a distal fragment of a first posterior phalanx with slight traces of burning from Maysar 6 and two camel astragali from grave 22 probably derived from a single individual were the only stratified remains). In the Uerpmanns' opinion these discoveries seem to certify the wild dromedary spread and define the boundaries between the mountain regions of south-east Arabia, Hajjar Mountains, and the coastal region, where dromedaries must have been rare or absent during the Post-Pleistocene (Uerpmann & Uerpmann 2003, 2008a: 470-472).

Another relevant find of huge importance to understand the role of camels in this period is the al-

Sufouh 2 site, in Dubai, where the faunal assemblage amounts to 18,000 camel bone fragments related, to at least 123 individuals (Driesch & Obermaier 2007; Driesch, Brückner, Obermaier & Zander 2008). The authors agree with the Uerpmanns' in attributing these remains to wild animals intensively hunted between the second half of the 3rd to the first half of the 2nd millennium BC.

Camel bones from Bronze Age levels have been retrieved from Qala'at al-Bahrain (Uerpmann & Uerpmann 1997) where a couple of osteological elements (an atlas of a young animal and a patella of an adult) date to previous phases than to 2000 BC. Other camel remains from Bronze Age assemblages in Bahrain from Saar (2000-1800 BC) have been also reported: a single camelid proximal phalanx and a large cervical vertebral fragment probably of a *Camelus* cf. *dromedarius* (Dobney & Jaques 1994). The authors argue domestic status for this camel due to the geographical situation of Bahrain (*contra* Uerpmann & Uerpmann 1997: 243). Afterwards four or five camel bones were identified by the Uerpmanns' (2002: 238) from other contexts of Saar: a neck vertebra, a rib, a controversial radius fragment, a piece of a femur and a tibia fragment.

The total bone assemblage of Tell Abraq amounts of some 100,000 items (Uerpmann 2001). The chronological sequence of the site (starting in the late of the 3rd millennium with layers of the Umm an-Nar culture and ending with the ed-Dur period -300 BC) deserves particular attention as it indicates, according to the authors, the presence of wild specimens during the first third of the Bronze Age, followed by a phase in which the scarcity of zoological data has to refer to overhunting activity. Nevertheless, dromedary reappears during Iron Age II showing a reduction of camel bone size that the authors derive from change of *status* from wild to domestic (Uerpmann & Uerpmann 2002: 256). The camel remains discovered at Muwaylah site, located on the eastern part of Sharjah and dated to the Iron Age II too (Uerpmann & Uerpmann 2002: 257), show the same range size of the contemporary phase of Tell Abraq. Only few larger bones, two second phalanxes and a patella, may reflect the presence of wild camels in the northern area of the UAE at the beginning of the 1st millennium BC.

Among the samples we considered to demonstrate the relationship between man and camel we included also what was retrieved in the Sharjah Emirate (UAE) during the historic and pre-islamic periods dating between 300 BC and 200 AD (Mashkour & Van Neer 1999; Uerpmann 1999). In particular the animal burials discovered at the protohistoric Mleiha site, first investigated during the 1994 campaign of excavation (Mashkour 1997). The graveyard included nine dromedaries and three hybrids (Potts 2004) that seem to have been a particular status leading to an understanding the role of camels in funerary rituals. We considered also the skeleton of a *c.* 6 years old female dromedary from al-Buhais 12 (Uerpmann & Uerpmann 1999), which lies around 17 km south of Mleiha, dated by radiocarbon analysis from stomach remnants at the end of Pre-Islamic Period (655-670 AD). The animal seems have been burnt during this chronological phase together with a warrior found some meters away in the same re-used Bronze Age grave structure.

The new dromedary evidence from HD-6 site, dated to the Early Bronze Age, may now be added to the data here reported.

THE CAMEL REMAINS FROM THE HD-6 SETTLEMENT AT RA'S AL-HADD

Since 1996, the Joint Hadd Project in the Sultanate of Oman has been investigating the Ra's al-Hadd site (HD-6), a settlement compound dated between the end of the 4th and the first half of the 3rd millennium BC (Cattani & Cavulli 2004; Tosi, Cattani, Curci, Marcucci & Usai 2001). The site is located on a coastal paleo-dune, in a small embayment to the south of Ra's al-Hadd, containing an ancient lagoon. This was a very favorable position, not only for the exploitation of coastal biomass, but also with respect to navigation for small watercraft able to cope with the overlapping currents at the entry of the Gulf of Oman.

HD-6 is the earliest Early Bronze Age (EBA) settlement excavated in the area and reflects the results of the 'Great Transformation' that affected the Oman Peninsula and the whole of eastern Arabia towards

the end of the 4th millennium BC. This site has a key role to understanding cultural dynamics in the Arab population during the "Magan Great Transformation Phase" which, as implied the name, is a period with more social and by economic changes (Cleuziou & Tosi 2007: 61-97).

The excavation at site HD-6, showing three main occupation phases (Periods 1, 2, 3), brought to light an architectural complex composed of a platform made of stone and clay, which is enclosed by a wall made of stone and mudbricks (Azzarà 2013). This relatively monumental structure is in association with multiple tumuli burials located near the site. Both elements suggest a developed social complexity for the tribal groups living in the region, likely affected by incipient accumulation and forms of interregional trade.

The well preserved anthropic deposits of HD-6 are very rich in faunal remains, both within and around the central walled residential complex. Quite expectedly there is a marked preponderance of marine species: a variety of fishes, along with remains of turtles (*Chelonia mydas*) and sea mammals (Cartwright & Glover 2002). A broad spectrum of marine resources were also intensely exploited; of significance for the human population were resources derived from marine mammals like dolphins for their flesh, fat and oil. Land mammals, both domestic and wild, and birds appear in a very small quantity. Nevertheless, the significance of land mammals is worthy of consideration, for their implications beyond subsistence and for their relation to the social-economic conditions. Domestic goats appear to have been the most frequent land mammals. This is expected considering the importance of their milk traditionally used by the coastal population of eastern Arabia to improve the potability of brackish water. Cattle were also present, but evidently the basic food requirements of the fishermen were largely satisfied by the fish, molluscs and crustaceans that densely packed all ecological communities between the lagoon and the pelagic waters.

Domesticates were providers of critical caloric contributions gathered mainly from their milk. Also fat would remain a decisive requirement for dietary strategies all year around and a good part of it was certainly derived from dolphins and turtles.

FIG. 2. — Lower teeth of *Equus* sp. from Ra's al-Hadd (HD-6) site (Photo: Joint Hadd Project).

Among the land mammal remains particular attention must be paid to those of some teeth and a metapodial bone of a small-sized equid as well as to those of a mandible and a tooth of a camel. The situation is rather controversial for both finds. The equid tooth remains probably belong to an ass: if wild (*Equus africanus*), domestic (*Equus asinus*) or onager (*Equus hemionus*), still has to be defined (Fig. 2). Bökönyi (1998) identified, among the wild equids of Ra's al-Jinz some equid remains as *Equus hemionus*, while Uerpmann (1991) considers all finds in southern and eastern Arabia to fall within the range of *Equus africanus*. Considering the social and economical transformation during the last quarter of the 4th millennium BC, authors generally agree on the domestic status of these animals (Uerpmann & Uerpmann 2012), increasingly used for transport as a basic asset of the emerging oasis settlements.

The main point of discussion from the camel bone finds is equally controversial. The remains are very few: they consist of a mandible fragment and a left third lower molar attributed

Fig. 3. — Third lower molar of *Camelus dromedarius* founded in an external sandy layer to a stone structure from the saline component. It presents large areas of combustion: **A**, lingual side; **B**, labial side; **C**, occlusal side (Photo: Elena Maini).

to a young adult animal on the base of the low degree of wear (Fig. 3). The tooth was discovered in an area in the eastern edge of the settlement, without particular architectural evidence, but rich in bone remains, likely deriving from a waste deposit (Fig. 4). The good preservation state of the organic component in the tooth and its diagenesis have secured a reliable dating of the sample. The radiocarbon dates fell between 2890-2580 BC[2], well within the Early Bronze Age (Period 1), which fits with the other ^{14}C results obtained from wood and marine shells[3] (Azzarà 2009).

The tooth size is quite large (L 51,6 B 21,1 mm) and comparable with that of a large adult male, probably hybrid, found at the more recent site of Mleiha (Sharjah-UAE) Grave 1 (L 52,0 B 25,2 mm) (Jasim 1999; Uerpmann 1999).

DISCUSSION

The main point of discussion from the camel bone finds in the Arabian Peninsula concerns essentially the period of its domestication and the relationship developed between man and camel at the beginning of the 3rd millennium BC.

The principal positions can be reduced to two. On one side, Hoch's hypothesis which generallyconsiders that camel domestication had been fully accomplished by the beginning of the 3rd millennium BC. In her scenario during the Umm an-Nar period camels were regularly used as transport animals, with a radical impact on the trade dynamics and the economy of the oases as a whole (Hoch 1979). On the other side, we have the view of the Uerpmanns' who consider the domestication of the dromedary to have taken place almost two millennia later, around the transition between the 2nd and the 1st millennium BC (Uerpmann & Uerpmann 2012).

2. LTL5135A = 4160 ± 50 BP (2890-2580 cal. BC 95,4% probability) – CEDAD – Centro di datazione e Diagnostica - Università del Salento (Brindisi), Italy.

3. A range of radiocarbon calibrated dates were supplied by three different laboratories. Three dates were provided by The British Museum Research Laboratory: 3016-2899 BC (BM 3075); 2883-2648 BC (BM 3076); 2894-2876 BC (BM 3077). The Centre de Datation par le RadioCarbone of Lyon provided a date of 3040-2886 BC. The CEDAD - Centro di datazione e Diagnostica - Università del Salento provided two calibrated dates: 2620-2330 BC (LTL5046A) and 3030-2870 BC (LTL5047A).

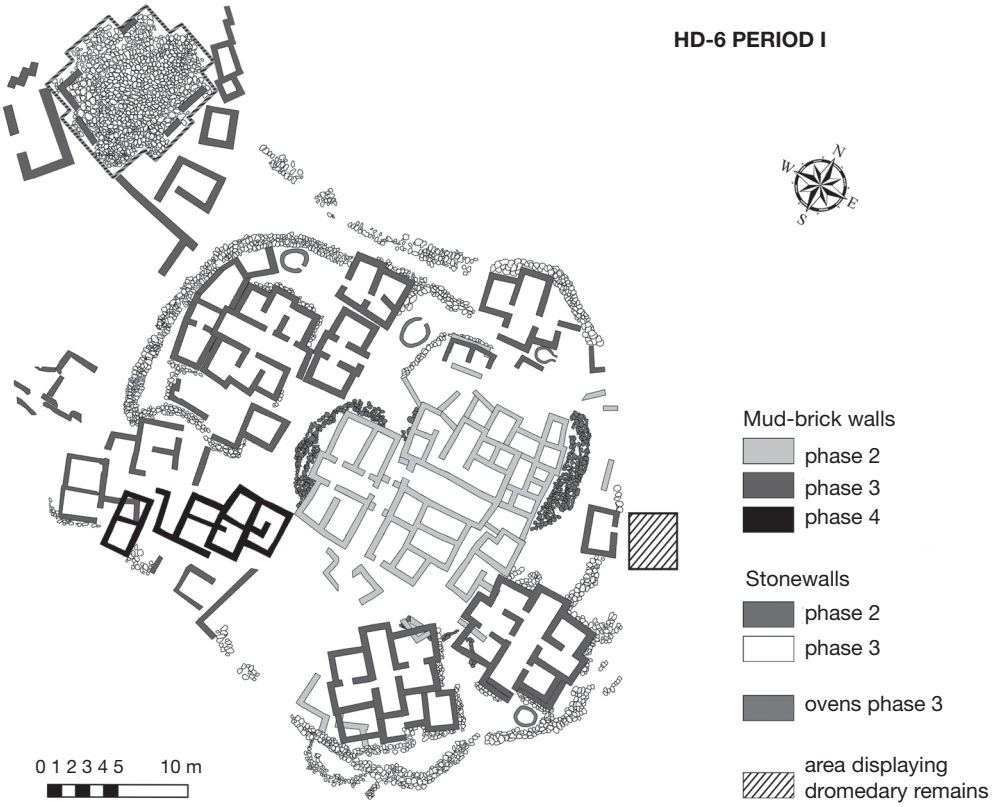

Fig. 4. — A plan of HD-6. The map displays the main occupation levels labeled as Period I (3100–2700 BC) and dromedary remains (Plan: Valentina Azzarà).

Both hypotheses are supported by numerous arguments and the discovery of the Ra's al-Hadd camel remains gives us the opportunity to re-examine this evidence jointly.

A first point regards the possible interpretation of dromedary status based on the evaluation of osteometric data. The general method used to determine the size is the calculation of the LSI (Logarithm Size Index), the logarithmic difference of the various measures detected and compared to the standard one[4]. Since this one, which represents one of the various size measurement methods (Meadow 1999), has already been applied on dromedary remains from the Arabian Peninsula (Uerpmann & Uerpmann 2002) therefore it was decided to employ it again adding new data published after that date.

First of all, in our opinion a method clarification on the collected data needs to be performed, as emphasized also by Meadow (1999) who highlights that the variations measured through this method are intended as variations according to a three-dimensional standard (length, width and depth) and the combination of length factors with width/depth ratios in the same metrical compari-

4. The applied formula is LSI= log x – log s, where x is the measure of the osteologic sample examined and s is the correspondent measure of the standard skeleton, namely dromedary CA4 from the Tübingen collection integrated in the missing measures of skeleton CA1 (Uerpmann & Uerpmann 2002). Point to be noted: these skeletons have previously been measured by Steiger (1990), however many measurements differ from the ones obtained by Uerpmanns' and cannot be used in the present case.

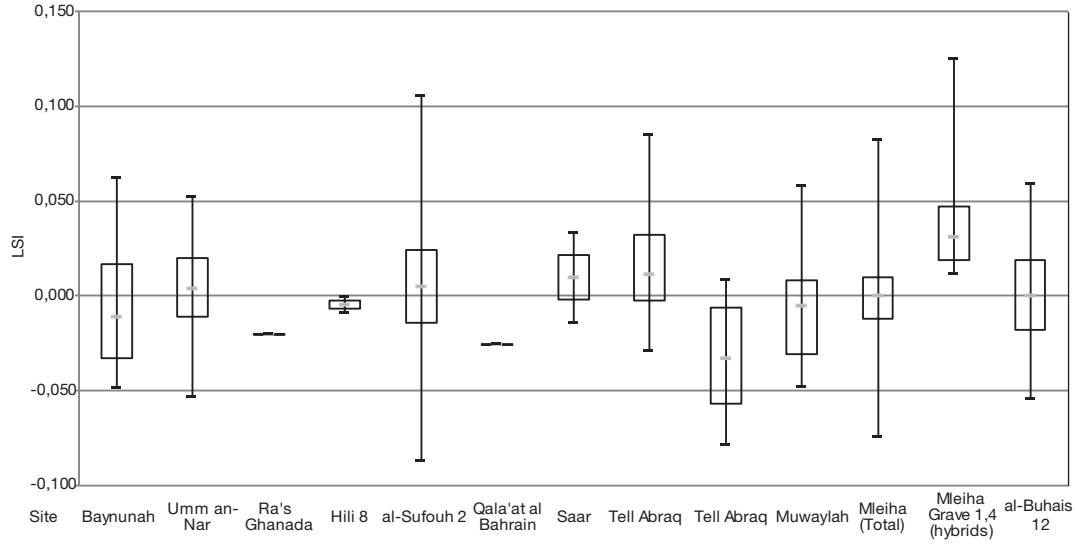

FIG. 5. — LSI-distributions for bone measurements of dromedaries from the Arabian Peninsula. Each element shows the minimum, the maximum, the median and the interquartile range box.

TABLE 1. — LSI-values displayed in Figure 1.

Site	Baynunah	Umm an-Nar	Ra's Ghanada	Hili 8	al-Sufouh 2	Qala'at al-Bahrain	Saar	Tell Abraq	Tell Abraq	Muwaylah	Mleiha (Total)	Mleiha Grave 1,4 (hybrids)	al-Buhais 12
Period	Stone Age	Bronze Age	Bronze Age	Bronze Age	Bronze Age	Bronze Age	Bronze Age	Bronze Age	Iron Age	Iron Age	300 BC-200 AD	300 BC-200 AD	655-670 AD
		unkn.						unkn.	unkn.	unkn.			
n. indiv.	>40	(++)	1	1	123	1	unknown	(++)	(++)	(++)	>10	2	1
n. value	24	45	1	2	779	1	2	20	17	17	24	15	25
min.	-0,0485	-0,0530	-0,0200	-0,0089	-0,0873	-0,0253	-0,0140	-0,0290	-0,0790	-0,0480	-0,0746	0,0113	-0,0540
max.	0,0619	0,0520	-0,0200	-0,0003	0,1052	-0,0253	0,0334	0,0850	0,0080	0,0580	0,0825	0,1251	0,0590
mean	-0,0048	0,0060		-0,0046	0,0065		0,0097	0,0166	-0,0335	-0,0078	0,0022	0,0391	0,0020
median	-0,0108	0,0040		-0,0046	0,0051		0,0097	0,0115	-0,0330	-0,0050	0,0004	0,0309	0,0000
dev. st.	0,0318	0,0219		0,0061	0,0314		0,0335	0,0284	0,0290	0,0272	0,0278	0,0306	0,0278

son diagrams should be avoided; ratios should be employed in order to highlight variation trends in time avoiding an over-interpretation of the available data.

We can consider the case of the multiple measurements taken from various anatomical elements of one female individual from the al-Buhais 12 burial, attributed to 655 to 670 AD (Uerpmann & Uerpmann 1999) that indicate a remarkable range of variability (Fig. 5). This wide range can be also seen when examining the data obtained from the Mleiha graves (Uerpmann 1999) where – in cases with more than one anatomical element available for each individual – the variability is rather high (Fig. 6). However, to understand the reason for this particular phenomenon is not simple, since measurements are limited and difficult to compare with each other. The dromedary case of grave 24 at Mleiha highlighted how the maximum median distance

was relative to the SD of the radius; practically, while the values of the other anatomical elements were close to zero - indicating that the individual of grave 24 was substantially similar to the standard - the SD radius value appeared higher and therefore more robust compared to the standard. Thus, assuming that measurements performed on different anatomical elements of the same individual can even give logarithmic variations close to ±1, we should arrive at the conclusion that the diagram obtained from all measurements is not significant, as the data exceeding from this range is little.

In order to overcome this limitation and to compare homogeneous data, we attempted to produce metrical comparison considering one anatomical element at a time. Such a procedure has significantly reduced the available measurements[5]. As a result, not all contexts were represented in the diagrams. The figure referring to the LSI calculated on the astragalus (Fig. 7) highlights how dromedary variation during the 5th millennium BC - considered as wild by all authors on the strength of their chronology- it is rather elevated and it is even higher in al-Sufouh 2 between the 3rd and the 2nd millennium BC (Driesch & Obermaier 2007; Driesch, Brückner, Obermaier & Zander 2008). The most prominent measurement is from Tell Abraq where a clear separation between Bronze Age dromedaries and smaller ones of the Iron Age can be noticed (Uerpmann & Uerpmann 2012: fig. 5). This observation leads the Uerpmanns to suggest that this phase could be attributed to the dromedary domestication (Uerpmann & Uerpmann 2002). Actually, both data from the other Iron Age sites and following ones demonstrate how the reduction in size cannot be confirmed at all. It is not possible to confirm that a size-reduction trend followed domestication, as the only possible cause. The most plausible hypothesis, according to us, is that the exclusive presence of small dromedaries from Tell Abraq may have accidentally resulted from the statistically low number of samples.

5. All measurements were used, as the fragmentation of the samples, did not allow the selection of one measure typology, for instance length measure.

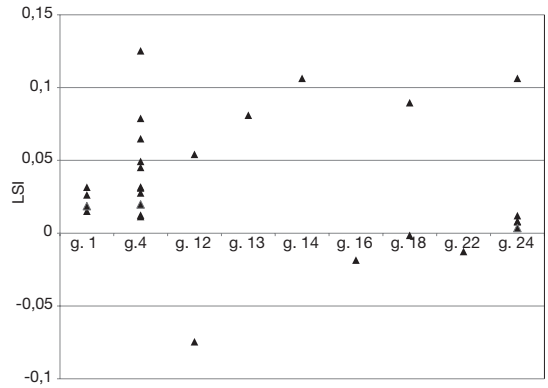

Fig. 6. — LSI-values of each individual from Iron Age Mleiha graves. Abbreviations: **g**., grave.

The latter hypothesis can be also confirmed by the humerus (Fig. 8) showing how the variability highlighted in the most recent sites falls entirely within the variability of the assumed Bronze Age wild dromedaries.

The Uerpmanns' (2002) hypothesis assumes that wild dromedaries continued to live in the desert borders of Oman, not far from the oases and after the end of the Middle Holocene these animals were hunted, like gazelles, ostrich and oryx, even after the 2nd and the 1st millennium BC.

Unfortunately, hunting activity of dromedaries during Prehistoric time is still poorly documented across the Arabian Peninsula. As previously mentioned, dromedary findings were recovered in a few Late Stone Age sites. Furthermore, in one of the main sites namely Baynunah (Beech, Mashkour, Huels & Zazzo 2009: fig. 8), the reason for the accumulation of dromedary remains cannot be explained, although the possibility of dealing with a kill-off site has been excluded (Beech, Mashkour, Huels & Zazzo 2009: 26).

Only after the Bronze Age towards the end of the 2nd millennium BC, dromedary presence in the Arabian Peninsula increases with a generally low frequency of findings compared both to other domestic and wild mammal findings and economic exploitation based on marine resources which seem to predominate. The site of al-Sufouh 2 (Driesch & Obermaier 2007) is an exception because it reveals the presence of

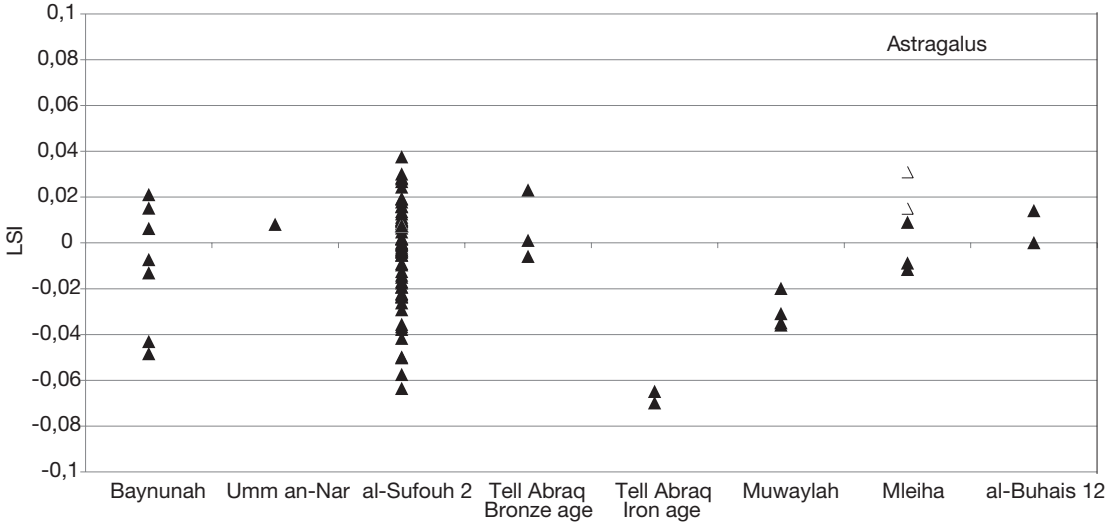

Fig. 7. — LSI-values calculated on the astragalus of dromedaries from Arabian Peninsula (empty triangles referring to hybrids).

dromedaries in an archaeological context. As in the case of Baynunah, this presence is not linkable to domestic or funerary structures of any type. Contrary to Baynunah, in al-Sufouh 2 site (Driesch & Obermaier 2007: 154), slaughtering traces were revealed – which could lead to the hypothesis that we are dealing with a specialized hunting and butchering site – although further study in order to thoroughly comprehend the animal use would be necessary[6]. An important point is emphasized by the authors comparing the age distribution of al-Sufouh with modern unguarded semi-wild herds in Algeria (Gauthier-Pilters & Dagg 1981). The age and sex distribution observed in these herds – semi-wild herds in southern Algeria – does not closely correspond to the results of their investigation at al-Sufouh 2, considering that hunters performed prey selections before initiating the taming and domestication. Moreover, in Umm an-Nar context (Hoch 1979), individuals of different age categories (adult, young and newborn) with completely representative skeletons, without any type of selection, were discovered. In the publication only the use of specific dromedary bones as needles or spindle whorls are mentioned without citing slaughtering traces. For this reason it remains unclear whether they were used for their meat.

The Umm an-Nar camel remains should be re-evaluated. Umm an-Nar was a coastal island surrounded by lagoons, hostile to most forms of life and not suitable to agriculture. The inhabitants of the island had an economy based mostly on fishing and sheep and goat farming and had a crucial role in trade of goods. When sea level was higher – 4,000-5,000 years ago – ships coming in high tide could anchor up close to the island. As a matter of fact, the position of the settlement suggests a use as a port of loading and discharge. Therefore, the geographical and environmental context do not contradict the possibility, already present in the publication (Hoch 1979), that dromedaries came to the town of Umm an-Nar under the care of man as domestic animals.

In addition to the osteological line of research, we are going to analyze the figurative record from

6. The authors of the investigation mention the presence of cuts and chop marks on the al-Sufouh bones, although in the publication only one picture of a radius with green-bone spiral fracturing traces on the diaphysis is presented (Driesch & Obermaier 2007: fig. 9); as the fracturing traces may, as well, have been caused by non-anthropic action (Haynes 1983) we highly hope for a future detailed taphonomic analysis on this material.

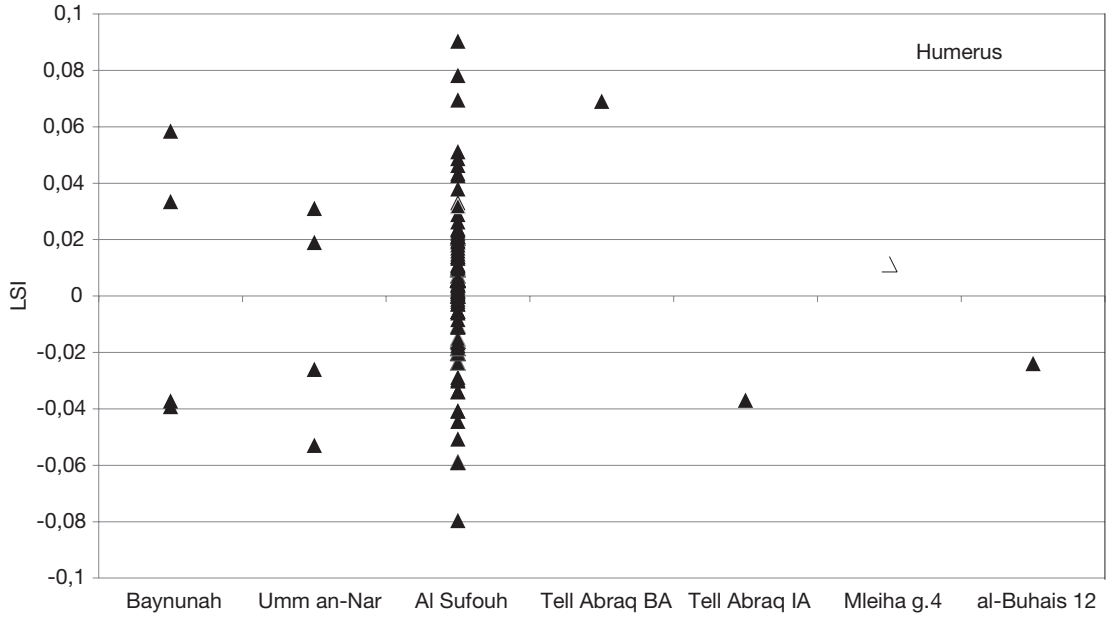

Fig 8. — LSI-values calculated on the humerus of dromedaries from Arabian Peninsula (empty triangle referring to hybrids).

the Arabian rock art in order to reveal what kind of relationship has been established between man and camel during the ancient times in the Arabian Peninsula. Camel figures are the most common elements of Arabian rock art during the Iron Age (Nayeem 2000) in the Sultanate of Oman and in the United Arab Emirates (Clarke 1975; Khan 1996), in Yemen (Anati 1968a, 1968b, 1972; Červiček & Kortler 1979; Inizan & Rachad 2007; Khan 2010). Evidently they became more common when the relationship between man and camel had been established, witnessed by representations of several structured riding camel scenes (Jung 1994). This time corresponds to the gradual change of style between prehistoric and Bedouin art (Khan 2000).

Our knowledge of Arabian rock art principally comes from the center and south-western inland part of the peninsula, where it is likely that the relationship between humans and animals have been preserved much more than the coast and the well watered highland between Oman and Yemen. Several camel depictions are known in this area from rock art sequences developed by Anati (1968a, 1968b; 1972). From south-western Arabia, respectively from Jebel Kawkab and Bir Hima, there are some wild camel scenes from the Phase I (6000-3500 BC), named "Early Hunters" (Anati 1968a: 138, fig. 91; Zarins 1989: fig. 14.7b), in "outline style" (Zarins 1982). From Phase II (3500-1900 BC) or "Early Pastoralist" (Middle Hunting and Pastoral Period II) carving relief of hunted camels came from the Jebel Kawkab area (Anati 1968b: 11, fig. 2) and from the Bir Hima region (Anati 1968b: 58, figs 6-15). The last one is the most famous scene from the Sha'ib Musamma open-air site, which is located in Central Saudi Arabia (Spassov & Stoytchev 2004). In Anati's analysis of this site, the rock panel presents three different phases. Our scene is part of a complex story composed by 27 depictions with 19 human figures, five animal figures, two mythological beings and one indefinite figure. There are eight scenes including hunting, duel-fighting, complex ritual and mythological scenes (Fig. 9). The animals depicted are ibexes, oxen and camels (Anati 1968b: figs 6, 7, 15). In the lower part of the panel, the scene shows

Fig. 9. — Sha'ib Musamma open-air site, Central Arabia. Rock art panel (Anati 1968b).

a dromedary wounded by four spears; a dog or a mythological figure (Anati 1968b: 62) is trying to arrest it by attacking its legs (Spassov & Stoytchev 2004: 152); two hunters armed with bow and dagger are on its front and back. On the right side of the animal, the human figure could have a prominent phallus as showed in another anthropomorphic depiction (Anati 1968b: fig. 11). Finally, an anthropomorphic figure with arms raised and with a weapon on his belt is inciting and directing the action (Fig. 10). The last figure presents a dagger at its waist. These weapons are frequent in the "Realistic-Dynamic Style" (Anati 1968b) and are mostly important to attempt dating this evidence. For example, similar daggers with broad blades and broad lunate pommels were depicted in Yemeni rock art (Jung 1991b) and were compared with similar copper weapons from Oman, which have been used during the Bronze (Nayeem 1996: 252) and the Iron Ages in the Arabian Peninsula (Cleuziou & Tosi 2007: 283, 291). These types of weapons have been reported in several Bronze Age northern Yemeni pictures of the so-called "Oval-headed-People Style" (Jung 1991a), held by warriors in the rock images of this style from Gabal Haid (Jung 1991a: figs 16, 25). Moreover, those weapons can be compared with similar objects of Bronze Age Anatolia, Syria and southern Mesopotamia (Jung 1991b: 270; Jung 1991a: fig. 18).

On a recent review of this rock art the evidence has been dated to *c.* 3000 BC. The authors stated that this scene dates back to the period immediately before domestication or the very beginning of domestication (Spassov & Stoytchev 2004: 156), when a strong relationship between man and camel spread in the Arabian Peninsula. Based on Anati's analyses, who cited a comparison with Syria and Palestine rock art (Anati 1968b: 70-71, fig. 17), the authors highlight a relation with Upper Egypt rock engraving scene from Jebel Uwenat open-air site (Spassov & Stoytchev 2004: fig. 3). They described this depiction as a representation of capturing/killing domestic cattle for meat supply and they consider this as "probably the oldest evidence for deprivation of property in the world" (Spassov & Stoytchev 2004: 153).

In our opinion the Sha'ib Musamma scene, as the Egyptian rock petroglyphs, may have a more

FIG. 10. — Sha'ib Musamma open-air site, Central Arabia. Rock engraving of group hunting of one-humped camel (*Camelus dromedarius*) (Spassov & Stoytchev 2004).

complex iconographic and iconological meaning. One might wonder if such representations have a symbolic rather than realistic value. In fact, two human figures represented have both bows and metallic weapons, while the third one clearly is not hunting the camel and may represents a mythological figure. This might suggest that the camel control and killing underlies a symbolic meaning and doesn't represent a scene of daily activity which could be a normal hunting scene. Although in Anati's opinion (Anati 1968b: 64-65) the depiction has been attributed to a simple hunting scene, we suppose that it may represents a ritual or mythological scene, in order to demonstrate the symbolic value of the camel for man. Finally, we will never know if the choice of these animals (ibex, lion, ostrich, ox, camel) could be related with their wildness.

Contrary to the Urpmanns' opinion (Uerpmann & Uerpmann 2002, 2003, 2012), about the discussed bas-relief of a standing dromedary from one of the collective graves of Umm an-Nar, the presence of camels together with the other wild ungulates doesn't show clearly the status of the dromedary, whilst the domestic status of donkey depicted on the Hili grave is accepted (Potts 2012: 55). On the other hand the archaeological evidence at Muwaylah shows the presence of domestic dromedaries in the form of several statuettes representing one-humped camels with a load or saddle on their backs dated to the Iron Age (Potts 2012: 88). The same can be said of the fragment of a bronze bowl decorated with images of two riders, one on an equid, the other one on a camel, found at pre-Islamic Mleiha (Uerpmann & Uerpmann 2012: fig. 7).

The presence of domestic dromedaries during the 3rd millennium is supported also by other sources and particularly by inscriptional evidence. Heide's (2011) revision of written sources shows that the Bactrian camel was domesticated before the dromedary and it was put into use by the middle of the 3rd millennium or earlier. In fact, *contra* Albright (1942, 1961), Heide states that both archaeological and written sources attest that domesticated Bactrian camel already existed in Abraham's time. During the patriarchs' daily life, however, the animal is not so important. On the other hand, the Near East written sources dated after the middle of the 2nd millennium BC, although copies of older traditions, attest that the dromedary was a domesticated animal, namely "donkey of the sea" (Albright 1942: 348, 352, 368).

The discoveries of the Danish Archaeological Mission at Umm an-Nar off the coast of Abu

Dhabi, where representations in relief on tombstones and osteological finds of camel are dated at homonymous period of the site, have revealed a convergence between Iran and the Arabian Peninsula in the more highly evolved farming communities, and in the domestication process of *Camelus bactrianus* and *Camelus dromedarius.* For the use of camels as a beast of burden, the earliest documentation dated at the beginning of the 2nd millennium BC with the representation of a camel on a plaque from Tell Asmar in Mesopotamia (Epstein 1971: 567) and the figurines of *Camelus bactrianus* from Altyn depe, Ulug depe and Gonur in southern Turkmenistan during the first half of the 3rd millennium BC (Zalkin 1970: fig. 4; Kirtcho 2009; Potts 2004).

Their great strength and draft capacity, combined with the meek, submissive character that makes it possible for few riders to control them in long trains and large herds, has turned camels into the most revolutionary innovation to colonize deserts and to develop long-distance overland trade networks across arid lands and steppes of the Eurasia, North Africa and the Middle East. However, this supreme quality should not overshadow the fact that as a large mammal camels were also a source of many different products. Not unlike other animal species systematically exploited since the Early Holocene in different regions of the world, juvenile and female camels, once captured from wild herds, could be kept for long periods of time among communities of farmers and herders, bound to tethering stones. They would provide many resources, not only meat and skins of slaughtered animals but also milk, hair, dung, urine and blood (Khan, Iqbal & Riaz 2003; Rathore 1986). Of course such resources can be only gathered from animals under degrees of human control.

Bulliet's contribution (1975) following the early seminal work of Dostal (1959) who considered most critical for the establishment of the Bedouin way of life the introduction of the 'north-Arabic saddle' that brought the desert nomads to global supremacy. The two different types of saddle discovered, the north-Arabic (*Shadad*) and the south-Arabic (*Hawlani*), also shown in Yemeni rock art too (Jung 1994) differ both structurally and for the rider positioning (upon and behind the hump), signifying different evolutionary paths. If the south-Arabic saddle offers less control of the animal, used for transport duties on caravan routes, the technology achieved by the populations of north-Arabia allows full control of the dromedary, which is used in raiding-warfare contexts (Sweet 1965). The evolution of the north-Arabic saddle, from the second half of the 1st millennium BC and of the south-Arabic saddle notoriously more ancient, together with the employment of dromedaries in transport and warfare alike signified full control on local and long distance trades by camel herders. This process created a system significantly most economically viable and efficient, no longer based on carts pulled by cattle and donkey, but uniquely on the camel's endurance, an innovation that gradually overtook transport wheeled (Macdonald 2009). All this facilitated not just the transfer, stocking or exchange of large quantities of goods, but also communication among urban and nomadic populations, creating alternative lifestyles and wealth based on trade and mobility.

Thus the diffusion of technology relative to wheeled vehicles is noticeable firstly in societies of the Central Asia, Ukraine, northern Europe, Caucasus and southern Russia, as far as Anatolia and Mesopotamia. Surely this structured technological development was connected to the presence, in Euro-Asian areas of metallurgical resources, while for those of the Near East the key was the trade of exotic and luxury products commissioned by the reigning elites. The domestication of the camel and its use in transport, along with the technological innovations of wheeled vehicles, allowed more efficient trading between Eurasia and Near East and allowed these communities to escape their dependency from agriculture.

In the Arabian Peninsula, instead, dromedary domestication and technological innovations relative to its control allowed an increase in trade and the employment of the animal for warfare allowed equal societies to increase their web of tribal alliances and to live outside the bonds of the urban space. These different evolutionary paths brought, during our era, certain populations to a global supremacy, through the conquest of wide

territories: the Arabs in the south, the Turks and Mongolians in the north.

CONCLUSIONS

In spite of recent discoveries, the overall available data on the dromedary domestication in the Arabian Peninsula remains too scanty to allow a detailed reconstruction of the domestication process through time. From the archaeozoological point of view the absence of dromedary remains during the Middle Holocene in sites such as Ra's al-Hamra and, above all, Ra's al-Jinz, could support Uerpmanns' (2002: 249) hypothesis that the wild ancestor of the Arabic camel did not move beyond the mountain escarpment that split the well watered lands of eastern Arabia between the coastal and the inner piedmont region, where these animals were rare or absent.

During the Bronze Age camel remains are geographically more spread, but always quantitatively low. In our opinion it is exactly the rarity of these remains (the same can be said for the ass) that could indicate a domestic or, at least, a tamed status of the dromedary. Nevertheless, since it is difficult to recognize dimensional and morphological variations during the early phases of domestication and we are substantially unable to identify skeletal differences between wild animal and tame ones, it turns out to be extremely hard to determine the status of the camel exclusively from an osteological point of view. The size reduction is a criteria traditionally connected with the process of the domestication but this paradigm is always more often questioned (Zeder 2012). However, at least, this is evidence related only to the end of the domestication process and it doesn't involve all the domestic animals.

The dromedary remains found at HD-6 are therefore important because they widen our knowledge about their spreading trajectory and because they raise an obvious question about their domestication or wild status. These camel remains do not contradict the Uerpmann's thesis that the wild camels in eastern Arabia were scattered across the desert wilderness between the Rub al-Khali and the Jiddat al-Harassis, to the west and south of the al-Hajar orographic spine that splits Oman. Likewise the overall archaeological evidence supports his assumption that camels came into regular and extensive use as pack animals for transport in this part of the Arabian Peninsula only much later, between the middle and late of the 2nd millennium BC (Uerpmann & Uerpmann 2002: 251). The use of the dromedary as a draught animal seems to have been the key in the social organisation of these south-eastern Arabian communities (Pastner 1971), which created, with the increasingly arid climate between 4000 BC and 3000 BC, a system of tribal alliances leading to centralization of regional commerce and the development of transoceanic trade routes towards the Indo-Iranian coast. The relationship between man and dromedary, within herders communities, shows significant discontinuity compared to that of the north-Arabic cultures. The area that would later merge into Arabia Felix (Hadramaut, Dhofar, Oman) represented a unique ecosystem, characterised by intense production and trade of incense and myrrh (Retsö 1991) and by a monsoonal climate – driven by the ocean presence – which allowed an integration of seasonal fishing and breeding of flocks and dromedaries. The latter were now also used to transport sardines to the nearby hinterland (Koller-Rollefson 1993: 187).

The data from HD-6 might give hints to a long-lasting process towards domestication that necessary started before clear attestation of domesticated animals could be found in the archaeological record.

In 1975, at the beginning of analyses by one of us, on the rich Early Bronze Age osteological assemblage recovered at Shahr-i Sokhta in Iranian Sistan, became necessary to define a more structured process of camel domestication – as a process involving intermediary stages of partial utilization was raised because the occurrence of a few bones combined with other non-osteological remains: camel hair woven in woollen cloth and, most significantly, a stock of camel dung sealed in a storage pot inserted in a floor dated to the middle of the 3rd millennium BC (Tosi 1969; Compagnoni & Tosi 1978: figs 2, 4). The conclusion was that the exploitation of camels begun much before they were used as pack animals that transformed the flow and potentials of overland transportation.

Little may be changed in the conclusive statement of that first presentation:

"*The domestication of the camel was thus a slow process of mutual assimilation that reached the height of its specialization only on the Eurasian steppe and in the subtropical deserts (of Arabia) under conditions not unlike those of the natural habitats of each species in the wild state. Because of the sporadic presence of small wild herds, the camel was perhaps always a rare animal until it was possible to increase its numbers by means of gradual symbiosis with the human community.*" (Compagnoni & Tosi 1978: 102).

In conclusion, we ought to look at the history of camel domestication as a parallel process of multiple exploitation, stemming from its unsystematic hunting in Early Holocene times, while other mammals were being brought in from outside as domesticates in human communities. This process involved communities who had also specialized in the exploitation of food resources from different ecosystems to combat Arabian aridity, combining oasis farming, desert herding and sea's fishing.

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