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THE FAUNAL REMAINS FROM TELL EL-MAFJER, A CHALCOLITHIC SITE IN THE LOWER JORDAN VALLEY, PALESTINE

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Abstract

Altogether 1925 animal bones, teeth, and mollusc shells were recovered during the first excavation season at Tell el-Mafjer in 2002. This faunal assemblage came from the Chalcolithic levels. Various animal species could be identified: cattle (domestic and wild), goats (domestic and wild), sheep (domestic and probably wild sheep), dogs, pigs and deer. No equine remains (horses and donkeys) were found. However, a certain number of marine, freshwater and terrestrial shells were present and identified. The relatively sedentary mode of life of the inhabitants of the site was based primarily on raising the main domestic species, sheep, goats, pigs, and probably cattle.

The trade relations, the ecological conditions, and the economy of the site during the Chalcolithic period will be discussed in this article.

Keywords: Archaeozoology, animal husbandry, shells, Levant, Near East, trade.

Résumé

Près de deux mille vestiges de faune ont été récoltés à Tell el-Mafjer au cours de la première campagne de fouille en 2002. Cet ensemble faunique provient de niveaux chalcolithiques. Des espèces variées d'animaux ont pu être déterminées : des bovins, des caprins et des ovins domestiques et probablement aussi des ovins sauvages ainsi que des chiens, des cochons et des cervidés. Aucun reste osseux d'équidés, ânes ou chevaux, n'a été identifié. Par ailleurs, un certain nombre de coquilles de mollusques marins, fluviatiles et terrestres sont présentes et ont été déterminées. Le mode de vie relativement sédentaire des occupants du site était basé sur l'élevage des principales espèces domestiques, les moutons, les chèvres, les cochons et également les boeufs. Les relations de commerce ou d'échange, les conditions écologiques et l'économie du site durant la période chalcolithique sont analysées dans cet article.

Mots-clés : *Archéozoologie, élevage, coquillages, Levant, Proche-Orient, commerce.*

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INTRODUCTION

The excavation of Tell el-Mafjer is a joint Palestinian-Norwegian project. The 2002 season was carried out under the supervision of Dr. H. Taha, the Director General of the Palestinian Department of Antiquities and Cultural Heritage and Professor Randi Halland, from Bergen University, Norway (Taha *et al*. 2004). The site is located 2 km north of the city centre of Jericho, about 200 m south of Hisham's Palace (*fig. 1*). The excavation at the tell yielded significant stratigraphic material from the Chalcolithic period (*ibid.*).

Fig. 1—Map showing Tell el-Mafjer within its regional context (from Mazar 1990, infography G. Devilder).

The animal bone samples from Tell el-Mafjer 2002 were recovered from area A (*fig. 2*), mostly by hand. Sieving and flotation techniques were also used, but to a lesser extent. Six squares produced faunal remains, mostly from square A3 (*table 1*).

The identification of the fragments, anatomically and to species, was carried out using our modern animal bone comparative collection. Schmid's well-known atlas of animal bones (Schmid 1972) was

also referred to in addition to other literature. It was possible to distinguish between sheep and goat bones (Boessneck 1969; Prummel, Frisch 1986). The caprines (O/C) category was used to represent the undetermined sheep/goat bones.

Due to the high fragmentation ratio, certain categories based on animal size were used to sort the unidentified fragments:

LM: large ungulate mammals, unidentified horse-cattle size.

MM: medium mammals, unidentified sheep-dog size.

SM: small mammals, unidentified rabbit-rat size.

Indet: indeterminate fragments.

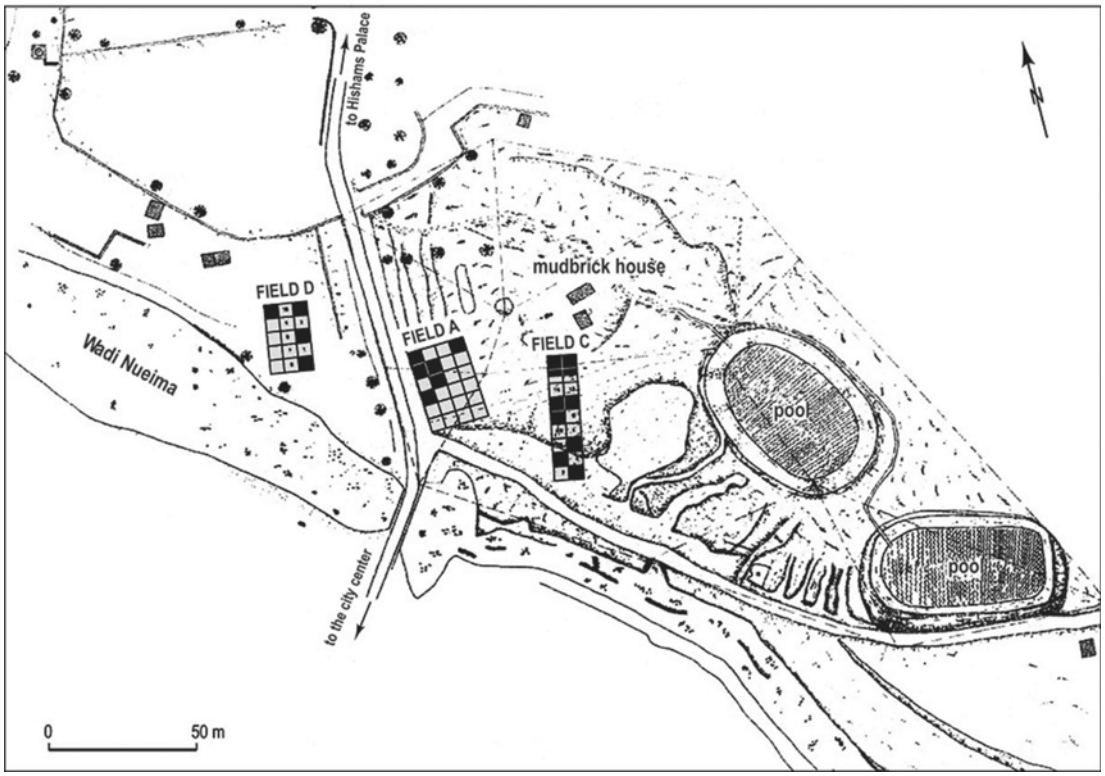

Fig. 2—Tell el-Mafjer site plan (from Taha et al. *2004, infography G. Devilder).*

Faunal remains	Squares						
	A3	A5	A6	A10	A11	A24	Total
Specimen (NISP)	539	157	324	351	327	227	1925
Percentage	28.0%	8.2%	16.8%	18.2%	17.0%	11.8%	100.0%

Table 1—Distribution of Tell el-Mafjer 2002 faunal remains throughout the various squares.

The reconstruction of the real quantitative composition of the original thanatocoenoses is never achieved by using any single method, as most methods have shortcomings when used alone (Vigne 1991). Due to the salty nature of the soil, the weight method is excluded. The minimum number of individuals (MNI) (Chaplin 1971) and the total number of identified specimens (NISP) were used.

All the measurements were taken according to the standards devised by von den Driesch (1976). The abbreviations from the same standard were used. Measurements were taken using slide callipers and a measuring box. All measurements are expressed in millimetres unless otherwise indicated.

Two main methods were available for estimating the age of an animal at time of death. The first method is by estimating the stage of eruption (Silver 1969) and by dental wear analysis (Payne 1973). The second method is by studying the state of epiphyseal fusion in the post-cranial skeleton, mainly the long bones (Silver 1969). The second method is less reliable because of the various taphonomic effects on the skeletons, especially on those of young immature individuals, and on those bones which have rich bone marrow or a high proportion of spongy matter, such as the proximal and distal parts of the femur and humerus in fatty animals like pigs. Furthermore, as the unfused epiphyses of the long bones tend to be more porous and softer than those of the fused epiphyses, the use of the epiphyseal method for the estimation of age usually overestimates the presence of older animals in the sample. Zeder's (2005) revised data regarding the age and sex of sheep and goat will also be applied.

Complete mandibles are preferable for estimation of the age based on the tooth eruption stage. This method can give accurate ages up to the point all the teeth have erupted. After that one has to depend on the state of tooth wear to estimate the age of the individual. Due to the high fragmentation of the sample, few mandibles were found and only some of them have teeth in place. Therefore, single teeth were also used to estimate the age of some species.

The sex of the animals can only be determined when sexual dimorphism is expressed in the skeleton. Such dimorphism is obvious in a small number of bones (Schmid 1972; Armitage 1982; Grigson 1982; Wilson 1982). In sheep, goats and cattle, sex was determined based on the horn cores (Grigson 1982). The sexing of pigs was determined based on the morphology of the canine teeth and on the canine roots (Schmid 1972).

Height at the withers could be estimated by measuring the length of certain long bones. These measurements were multiplied by specific factors compiled by von den Driesch and Boessneck (1974).

DESCRIPTION OF THE FAUNAL MATERIAL

The Tell el-Mafjer archaeozoological sample of 2002 is composed of 1925 bone fragments (Al-Zawahra 2006). Most of the remains were recovered from square no.3 (*table 1*).

As table 2 shows, the studied sample includes bones from mammals (both domestic and wild). Marine, freshwater and terrestrial mollusc shells were also identified.

Altogether 1294 (67.2%) specimens from the sample could be identified to species level. Most of the fragments are from mammals, represented by 79.4% of the identified fragments. Molluscs make up 20.6% of the sample, dominated by the freshwater *Melanopsis praemorsa*. A total of 32.8% of the sample could not be identified to either species or family. They were sorted according to their size, as large or medium mammals. Medium-sized mammals make up 22.6% of the unidentified fragments (*table 2*).

In general, the remains are fragmented and show many modifications. Approximately 1.4% of all the bone fragments show cut marks or evidence of butchering; 2.4% of the bone remains are burnt or calcined and 0.1% show marks from gnawing. 0.2% of the assemblage shows signs of pathology. The high ratio of cut-marked bone fragments indicates that these excavated animal remains were food waste (*appendix A-D*).

MOLLUSCS

The molluscan fauna from Tell el-Mafjer is represented by local terrestrial and aquatic species, which include marine and freshwater shells. These shells make up 20.7% of the assemblage. The majority of them were concentrated within square no.3 (*table 2*). Fresh water molluscs (*Melanopsis praemorsa*) dominate the sample and make up 18.0% of the assemblage. The majority of these were recovered from square no.3.

The freshwater shells are also represented by *Unio terminalis.* Land snails are represented by *Levantina caesaraena* and *Monacha haifaensis*, which are a minority among the shells. Marine shells make up 1.5% of the studied sample (Al-Zawahra 2006), mostly from the genus *Cardium*. They are represented by *Conus mediterraneus*, *Phalium sulcosum*, *Glycymeris violascens*, *Tridacna maxima* and *Cerastoderma glaucum* (Bivalvia). All of the marine shells are of Mediterranean origin except *Tridacna maxima*, which comes from the Red Sea.

Species	Squares							
	A3	A5	A6	A10	A11	A24	Total	%
Pigs (*Sus* sp.*)*	108	26	37	55	60	33	319	24.7
Dog (*Canis lupus* f. *familiaris)*	-	1	-	2	-	-	3	0.2
Sheep (*Ovis ammon* f. *aries)*	21	5	4	12	11	8	61	4.7
Goat (*Capra aegagrus* f. *hircus*)	12	2	10	18	10	7	59	4.6
Sheep/goat	64	31	89	74	89	55	402	31.1
Cattle (*Bos primigenius* f. *taurus*)	23	14	57	21	35	10	160	12.4
Total Domestic	228	79	197	182	205	113	1004	77.6
Cervidae	2	-	1	-	-	-	3	0.2
Wild goat (*Capra aegagrus*)	1	-	1	-	1	-	3	0.2
Wild sheep (*Ovis orientalis*)	-	-	-	-	-	1	1	0.1
Gazelle (*Gazella gazella*)	5	2	1	1	1	4	14	1.1
Wild cattle (*Bos primigenius*)	-	-	-	1	-	-	1	0.1
Total Wild	9	2	3	2	1	5	22	1.7
Cardium (*Cerastoderma glaucum*)	8	1	-	-	-	2	11	0.9
Conus (*Conus mediterraneus*)	1	-	-	-	-	-	1	0.1
Glycymeris violascens	3	-	-	-	-	-	3	0.2
Levantina caesaraena	1	-	-	2	-	-	3	0.2
Tridacna maxima	2	-	-	-	-	-	2	0.2
Melanopsis praemorsa	175	-	26	28	2	2	233	18.0
Monacha haifaensis	-	-	1	6	-	-	7	0.5
Phalium spc.	1	-	-	-	-	-	1	0.1
Unio terminalis	2	-	-	2	-	-	4	0.3
Unidentified shells	2	-	-	-	-	1	3	0.2
Total Mollusc	195	1	27	38	2	5	268	20.7
Total Identified	432	82	227	222	208	123	1294	67.2
Large-sized mammals	25	17	41	21	29	25	158	8.2
Medium-sized mammals	82	55	52	100	76	71	436	22.6
Indeterminate	-	3	4	8	14	8	37	2.9
Total unidentified	107	75	97	129	119	104	631	32.8
Total	539	157	324	351	327	227	1925	100.0

Table 2—Number of animal remains of Tell el-Mafjer 2002 throughout the various squares.

DOMESTIC MAMMALS

For each of the domestic bone fragments, especially those of the pigs, a possible presence of wild specimens should be taken into consideration. The morphological criteria that distinguish between wild and domestic specimens could not be used due to the high ratio of unfused bones for the pigs. For this reason, besides the archaeological contexts of the records, metrical analysis was also used. A total of 1004 bone fragments could be identified as coming from domestic animals. The domestic mammals make up 77.6% of the total identified specimens. Caprines bones are predominant among the domestic mammals and comprise 40.4% of them (*table 2*). They are followed by the pig bones (24.7%) and then by the cattle bones (12.4%). Most of the bones modified by butchering, burning, chopping and gnawing belong to domestic mammals.

Sheep (Ovis ammon *f.* aries) *and goats* (Capra aegagrus *f.* hircus)

The bones of sheep and goats dominate the domestic animal remains. Sheep and goat bones are represented almost equally (61:59). The bulk of the specimens belong to the *Ovis/Capra* (Caprine) category (31.1%). As a whole, the MNI of sheep and goats is estimated at 44 individuals (Chaplin 1971), as follows: 7 goats (right scapuli), 10 sheep (left radii) and 27 *Ovis/Capra* (right humeri). Only a few fragments of the medium-sized mammals could be identified to either gazelle or fallow deer; all the rest belongs to sheep and goats (*table 2*). This indicates that the majority of the medium-sized mammal bones could also be from either sheep or goats. Due to the similarity between their bones, the Caprine category was used for these.

A further 59 bone fragments could be identified with certainty as domestic goat and approximately an equal number as domestic sheep (61 fragments). The other ovicaprid bones number 402. All of the skeletal elements of sheep and goats are represented in the assemblage.

The distribution of Caprines elements was spread throughout the various squares. They were mostly recovered from squares A6, A10, and A11. The cranial bone fragments (tooth, skull, mandible) dominate these specimens at 42.8%. The teeth and the mandible fragments were over-represented among the cranial specimens. The forelimb bones, the humerus and radius fragments, were less frequent.

One third of the sheep bones came from square A3. Radius bones, the proximal ends, dominate these specimens, followed by humerus fragments, mainly distal ends. The compact bone-rich specimens like the astragalus bones are well represented in the sheep assemblage. One proximal phalanx was recovered from square A24. Its measurements lie outside the domestic range. This specimen could be from a wild sheep.

Unlike the sheep bones, the goat bones were found mostly in square A10.

The goat bone specimens from square A3 were less numerous than the sheep bones. Humerus bone fragments dominate these specimens, followed by scapula fragments and then by horn cores. The absence of phalanges II and III may have to do with skinning practices, when they may have been removed with the skin. Three fragments of goat horn cores were identified. Two of them were recovered from square A6. Their morphological features and measurements identify them as wild.

The bones of domestic goats and sheep from the different squares are represented respectively in table 3.

Table 3—Distribution of the remains of caprines (goats, sheep or sheep/goats?) throughout the various squares.

Square	Sheep/goat	Goats	Sheep
A3	64	12	21
A5	31	2	5
A6	89	10	4
A10	74	18	12
A11	89	10	11
A24	55	7	8

A total of 11 bones show cutting or butchering marks: three sheep bones, one goat bone and seven Caprines bones. From the sheep two astragali were recovered from squares A3 and A24. Both display marks of dismemberment due to the separation of metatarsal bones from the distal tibia (Binford 1981). One sheep femur recovered from square A24 has a cut mark on the dorsal neck of the proximal head. It is a result of secondary butchering where the femur unit was separated from the acetabulum part of the pelvis bone of the carcass. One goat distal humerus has a cut mark from dismembering, on the articular facet of the distal trochlea. These marks are due to segmentation of the lower part of the upper forelimb. Seven other bone fragments have cut marks: one metacarpal from square A5, two mandible fragments from squares A6 and A10, one femur fragment from square A11, one radius fragment from square A11, and one pelvis and one humerus fragment from square A24 (*appendix A*). These marks vary from primary to secondary to skinning/butchering marks (Binford 1981).

Thirteen bones of Caprine specimens are burnt or have marks of calcination (*appendix B*).

One Caprine mandible fragment was recovered from square A5 and one distal part of a metapodial from square A24. Both of them display signs of pathology.

A few sheep and goat bones were measured. All of the measurements and abbreviations used are according to Driesch's standard (von den Driesch 1976). The measurements were found to be within the size range of domestic animals except those of the goat horn cores and one sheep first phalanx (measurements *table 4*).

Sheep Phalanx I	Tell el Mafjer	Wild range
Proximal Width	14.1	11.7-19.9
Distal Width	12.8	12.2-20.3
Maximal Length	39.6	
SD	11.4	

Table 4—Comparison of sheep measurements (Phalanx I).

The fragmentation ratio was very high among the sheep and goat bones, a result of various activities, natural and cultural, as shown by the butchering marks.

Isolated teeth are numerous among the sheep and goat remains, whereas most of the mandibles are fragments without their teeth. For the estimation of sheep and goat slaughtering ages, the fusion rates of long bones were used (Silver 1969), as well as the few mandibles still containing their teeth (Payne 1973). The fusion rates of the long bones (Silver 1969) show that in general most of the sheep and goats were killed or died in old age. No animals from squares A3, A11 and A24 were found to have been killed younger than their first year. Just a few ratios from the other squares indicate that the animals were killed during their first year, possibly due to natural factors. Goats were usually killed when older than 2 years (A3 et A5: 83.3%; A6: 66.6%; A10: 66.7%; A11: 55.6%). On the other hand, square A24 indicates a different tendency, that all of the animals were killed between the ages of 1 year and 3 years.

The dental information supports the fusion information which indicates that most of the animals were killed when older. One third of the animals from square A3 were killed when older than 6-8 years, 75% from square A5 were killed when older than 4-6 years, as were 42.8% from square A6. From square A10, 60% of the sheep and goats were killed at about 6-8 years. On the other hand, 62.5% of the animals from square A11 and 75% from square A24 were killed at about 2-3 years.

Cattle (Bos *sp.*)

The cattle assemblage from Tell el-Mafjer 2002 contains 161 specimens (*table 2*), almost all from domestic animals. The identification of them as domestic cattle was based mainly on the measurements. One exception (A10.10.10a, no. 620) is an incomplete second phalanx, Phalanx 2, with a distal breadth of 33.1 mm (see discussion in wild mammal section).

Cranial remains dominate the cattle bone sample (32.5%) and teeth dominate the cranial specimens (73.1%). Foot bones come second at 15.0%, followed by humerus and radius bones. At least eight individuals were estimated to be represented among the specimens according to the MNI method (Chaplin 1971). There is obviously a predominance of the bones which carry little meat, the skull and the foot bones, which together make up roughly half of the sample. Square A6 has the highest ratio of cattle remains (35.6%). This may indicate a particular function for that spot, such as butchering and cooking activities. Approximately all of the skeletal elements of cattle are present, which indicates the raising and consumption of cattle at the site. The low percentage of the bones carrying the highest proportion of meat in the assemblage, *i.e.* humerus, femur, scapula and pelvis, may have to do with the distribution of the carcass parts on the site.

The dental data from the cattle show that no animal was killed young. All of them were killed either as adults or older (three lower third molars with tertiary wear, 2 with secondary wear and 2 with primary

wear). The long bones provide more data on the age at death of the cattle. No animal younger than two years was killed, while 71.4% of the animals had passed their third year. More than half of the cattle survived into old age.

No complete long bones enabling estimation of shoulder height were recovered. Many bones show marks of butchering; dismembering, de-fleshing and skinning (*appendix A*). 10 bones present cut marks (6.3% of the cattle bones). Five astragali, two from square A3 and another two from square A6, have cut marks in the middle of their medial sides, from dismemberment and butchering, and one from square A24 also has a dismemberment mark (Binford 1981). On a frontal bone of a skull, at the base of the horn core, is a skinning mark; two distal humeri have cut marks on their distal ends, and there are dismemberment marks exactly on the articular facets of one distal scapula and one distal metatarsal. The cut on the distal metatarsal bone is a skinning mark from removal of the skin out of the phalanx area. Two cattle bones show burnt marks: a proximal end of a radius from square A6, and a proximal phalanx from square A3 (*appendix B*). A gnawing mark from a dog is present on the distal end of a humerus bone (*appendix C*). Marks left by pathology could also be detected on the cattle bones. One proximal phalanx 1 has signs of exostosis on the medial face of its distal plantar side. The severe inflammation resulted in a deformation of its shape. Bone inflammation can be divided into three types (osteoperiostitis, osteomyelitis, and osteitis), but it is often difficult or even impossible to determine which type is present when dealing with archaeological material (Baker, Brothwell 1980; Baker 1984). Striation marks could be seen on one astragalus and on one ulna bone (*appendix D*). The astragalus bone, which was recovered from square A6, has many striation lines, mainly on the dorsal side, and a few lines on the medial side. Besides these striation marks, there are signs of exostosis on its medial face. One proximal end of a cattle ulna was found and has a striation mark on its semi-lunar arch. The exostosis signs as well as the striations are on the articular facets of the bones, indicating pathology that is a result of traction or heavy labour (Baker 1984). This may indicate that cattle were kept for working (Bartosiewicz *et al*. 1997). Cattle were also exploited for milk; the earliest firm evidence for the use of cattle as providers of milk comes from the ancient civilizations of Egypt and Mesopotamia and dates from the 4th millennium BC (Clutton-Brock 1987).

*Pig (*Sus scrofa *f.* domesticus*)*

Pigs are represented by 319 specimens, tooth and bone fragments, making up 31.8% of the domestic mammals and 24.7% of the identifiable specimens (table 2). Most of the pig assemblage was recovered from square A3 (33.9%). The minimum number of individuals, MNI, is estimated at 26 individuals (right tibia): 17 from square A3, 3 from square A6, 4 from square A10 and 2 right tibias from square A11 (Chaplin 1971). All anatomical elements are represented and are distributed throughout the various squares. The cranial unit bones consist of 33 skull fragments, 34 mandible fragments, 25 teeth (complete and fragments), and 10 maxilla bone fragments. The mandible fragments (33.3%) dominate the pig remains, followed by the skull fragments. Most of the mandible fragments were recovered from square A3 while most of the skull fragments were recovered from squares A10 and A11. Tibia bone fragments make up 13.8%, followed by radius fragments at 8.5%. The bulk of the pig specimens are from immature animals. Most of the long bones have unfused ends. One scapula was found in A3 and appears to belong to a foetus from its size and appearance (GLP = 9.9 mm ; SLC = 7.2 mm). The measurements of individual bones indicate that these animals were domestic. Theoretically, some measurements could fall within the extreme lower range of wild pig. The unfused long bones from immature animals render the situation more complex.

Most of the pigs lived beyond their first year (A3: 85%; A5: 75%; A6: 100%; A10: 60%; A11: 64,3%; A24: 66,6%). Very low percentages of them died during their first year, possibly due to natural factors. However, the bulk of the animals was killed between their first and second years, after gaining their maximum weight. From square A3, 76.5% of pigs were killed between 1-2 years, from square A10, 80% of them, while all of them were killed at this age in squares, A5, A11 and A24. No pigs were found to be older than 3 years of age, according to the fusion rates of the long bones (Silver 1969). However, the dental data from the lower third molar (M3) which erupts around 3 1/2 years, shows that 20% of the pigs lived beyond

this age, older than 3 1/2 years, while 80% of all the animals were killed when immature. These older pigs may be the adult females which were kept for reproduction. The fusion data and the dental data indicate the same possibility, that pigs were mainly exploited for meat production (Al-Zawahra 2004), and that the strategy was to keep the offspring until they attained a maximum weight, which occurred around 1-2 years. The older females where killed when no longer useful for reproduction.

The high ratios of the cultural modifications among the pig bones are the result of food preparation and exploitation to provide a protein source for the inhabitants of the site during the Chalcolithic period.

*Dog (***Canis lupus *f.* familiaris*)***

Dogs are represented at Tell el-Mafjer by only three bones. They make up a very low percentage compared to the other species. One fragment of a lower mandible and two foot bones were recovered. Neither cuts nor cultural marks are present on any of them. The transverse fragment of the mandible was recovered from square A5. A proximal phalanx and a metatarsal IV (Mt IV) were recovered from square A10 (cf. measurements *table 5*).

The very low percentage of dog bones among the faunal remains at Tell el-Mafjer 2002 may have to do with their exploitation for reasons other than for meat. Dogs may have been regarded as unclean animals. If so, their remains would probably have been discarded outside the habitation area.

Mandible	
Height behind M1	24.3
Phalanx I	
GL	18.7
SD	4.2
BD	5.6
Mt IV	
GL	80.1
BP	7.1
BD	9.2

Tabl. 5—Measurements of some dog remains.

WILD MAMMALS

Twenty-two bone fragments could be identified as wild mammals among the Tell el-Mafjer animal bones. They make up 1.1% of the whole sample and 1.7% of the identified fragments. The Mesopotamian fallow deer, gazelle, wild goat, wild cattle, and probably wild sheep were identified (*table 2*). The gazelle remains are dominant and were found in all the squares, especially squares A3 and A24 (see the distribution of skeletal elements and measurements *table 6, 7*).

All of the gazelle long bones are fused and one horn core was burnt. On the basis of the horn core morphology and on the zoogeographical distribution of gazelles (Tchernov *et al*. 1986/1987) in the Near East, this species is the mountain gazelle, *Gazelle gazella.* Moreover, the mountain gazelle was identified among the faunal remains from the Early Bronze Age context at nearby Tell es-Sultan (Alhaique 2000).

Fallow deer are represented by two scapuli fragments which were found in A3 and one antler fragment from A6.

Wild cattle are probably represented by two specimens, one second phalanx and one proximal radius. From the metrical point of view, these specimens may belong to *Bos primigenius*. One incomplete phalanx 2 was found in A10. Its distal width lies outside that of domestic cattle (Bd: 33.1 mm). This metrical value is higher than those of wild cattle found at Late Neolithic Sabi Abyad and is similar to another metrical value from specimens in the Neolithic levels at Tell Assouad, which date to the mid-seventh millennium

(Wijngaarden-Bakker 1989). Another specimen with large metrical data is the partly broken proximal radius which was recovered from square A6 (Bp : 82,8 mm, BFp: 78,2 mm). These specimens are probably from *Bos primigenius.*

Square	Cranium	Vertebra	Forelimb	Hind limb	Feet
A3	5 horn cores				
A5				1 tibia	1 phalanx I
A6		1 axis			
A10				1 tibia	
A11	1 horn core				
A24	1 horn core		1 scapula 1 humerus		1 astragalus

Table 6—Distribution of the skeletal elements of Gazella.

Astragalus	
GLm	25.2
GLl	26.1
BD	16.1

Phalanx I	
Glpe	37.1
Bp	11.5
Bd	10.6
SD	8.9

Table 7—Measurements of some gazelle remains.

Wild sheep and goats

A horn core of a goat with an almond-shaped cross-section at its base was found. This specimen can be attributed to the wild goat (*Capra aegagrus*), based on the almond shape of its cross-section and on its anterior keel. These two morphological features are typical for wild goats (Dayan *et al*. 1986; Uerpmann 1987). Moreover, the massive size of the horn core supports this identification.

The wild goat, *Capra aegagrus*, is especially represented in the eastern half of the Fertile Crescent, particularly in the Zagros Mountains (Uerpmann 1987; Hole 1996; Zeder 1997, 2005), while wild sheep, *Ovis orientalis*, were quite common in lower elevations of the Zagros. They seem to have been more abundant at the apex of the Fertile Crescent, northern Mesopotamia and southern Anatolia. Both wild sheep and goats may have been absent, or at least very rare, in the Levant (Zeder 1997). Nevertheless, their remains were found in Palestine in an Upper Palaeolithic context at Al-Wad (Uerpmann 1987), and at Epi-Palaeolithic Ein Gev on the eastern side of the lake of Tiberias (Davis 1974). Clutton-Brock (1979) reported some specimens from the early layers (Proto-Neolithic 10,000-8,000 BC) of Jericho. The discovery of sheep and goat remains outside the range of their wild ancestors at Pre-Pottery Neolithic sites such as Jericho in Palestine, Beidha (goats) in Jordan, Tell Aswad (goats) in Syria, and Abu Hureyra on the Syrian Euphrates has been taken as direct evidence of domestication (Kirkbrige 1966; Perkins 1966; Clutton-Brock, Uerpmann 1974; Hecker 1974; Ducos 1993; Legge 1996; Hesse 1997a). The presence of both wild sheep and goats in Palestine, outside their natural range, indicates that they were locally domesticated and not imported from the north (Uerpmann 1987; Hole 1996). Moreover, the presence of wild ancestors of Caprines during the Chalcolithic period sheds light on their southern distribution into the lower Jordan Valley and on their economic role in providing meat for the Chalcolithic Tell el-Mafjer inhabitants.

THE INDETERMINATE FRAGMENTS

A total of 631 bone fragments, 32.8% of the whole sample, could not be identified either to family or to species. Instead, they were sorted according to their size. The medium mammal bones make up 22.6%, followed by the large mammals at 8.2% (*table 2*). This relatively high ratio of unidentified bones is a result of the high degree of fragmentation, but demonstrates at the same time that recovery during the excavation was not biased towards the well-preserved bones.

DISCUSSION

Taphonomic Groups

Gautier (1987) used the concept "taphonomic group" to bring together all the animal remains that had been subjected to the same taphonomic history or path. This path begins from the moment of death of the animals involved until the discovery of their remains (Lyman 1994). As in most archaeological assemblages, the majority of the animal remains represent food refuse, but several other taphonomic groups are represented as well. The molluscs are the most diverse in terms of their taphonomic paths, which is indicated by the fact that they turn up in almost every taphonomic group. The "penecontemporaneous intrusives", are animals that were brought unintentionally to the site by people or by other agents at times, more or less, contemporary to the occupation. To this group belong the fresh water molluscs, *Melanopsis praemorsa*, from Tell el-Mafjer. They were usually concentrated in the construction phases (Ezzughayyar *et al*. 1996). They were probably brought to the site in the mud from the nearby Wadi Nuemi that was used to manufacture mud bricks. However, it has been suggested that these molluscs were introduced to the site intentionally to be crushed and used as a clay temper (Kooji, pers. comm.). Another group of land molluscs, *Monacha*, entered the site shortly after it was abandoned and covered by weeds (Bar-Yosef, Heller 1987).

Some shells have manufacturing marks, one *Conus*, one *Phalium* lip and one *Glycymeris* shell, the "workshop refuse" group.

Many of the bones show butchering, skinning, dismembering and de-fleshing marks. Other bones show chopping marks, related to marrow extraction (Binford 1981; Lyman 1982; Hesse, Wapnish 1985). This indicates that the majority of the Tell el-Mafjer animal bones can be considered as a "consumption refuse" group (Gautier 1987). Gnawing marks were also detected among the non-human modifications of the sample.

Palaeoeconomy

Meat for the inhabitants of Tell el-Mafjer during the Chalcolithic period was supplied by the exploitation of domestic mammals as well as wild animals. This primary exploitation strategy was mainly based on domestic animals (sheep, goats and pigs). Wild animals (mainly gazelle, fallow deer and possibly shellfish) played a role but were not significant to the diet of the inhabitants (*table 2*). Domestic animals make up almost 77.6% of the identified remains. Sheep and goats were the most numerous species in the inhabitants' economy, followed by cattle and pigs.

The fusion rates of the long bones show that in general most of the sheep and goats were killed or died in old age. No animals from squares A3, A11 and A24 died younger than one year of age. In the other squares, just a few were killed during their first year. Almost all sheep and goats from A3 and A5 were older than 2 years at death, and more than half from squares A6, A10 and A11. The dental information supports this evidence based on the fusion information, indicating that most of the animals died when older. This situation is typical for the secondary exploitation strategy, wool, milk and diary production (Clason

1974; Davis 1976; Epstein 1985). The presence of many bone spatulae, which may have been used in wool weaving (Friend 1998), as well as many points which were used for perforation may support the evidence for wool production at the site. However, square A24 shows a different tendency, all of the animals having been killed between 1 and 3 years of age. This pattern of production was typical for meat production (Payne 1973; Stein 1986; Wattenmaker 1987; Wapnish, Hesse 1988). Sheep and goats usually reach their maximum weight around 1.5-2.5 years (Payne 1973; Horwitz 1989).

On the other hand, according to their dental data, the cattle were not killed when immature, but when adult and even older. No animal was killed younger than two years, while 71.4% of the animals survived their third year. More than half of the cattle survived into old age. This reveals a secondary exploitation strategy in which cattle were used for their strength and for their milk rather than for their meat. The meat might have been exploited after the animals were older or ill.

Signs of pathology could also be detected on the cattle bones. One proximal phalanx I has signs of exostosis on the medial face of its distal plantar side. This severe inflammation resulted in a deformation of its shape. Striation marks indicating traction could be seen on one astragalus and on one ulna bone. The astragalus bone has many striation lines, mainly on its dorsal side and few lines on the medial side; besides these marks, a sign of exostosis is present on its medial face. One proximal end of a cattle ulna was found and has a striation mark on its semi-lunar arch. The signs of exostosis as well as the striations are on the articular facets (the joints) of the bones, indicating hard labour.

Most of the pigs, on the other hand, were killed when immature. Very low percentages of them were killed during their first year, which may have been due to natural factors. However, the bulk of the animals was killed between their first and second years, after reaching their maximum weight. The optimal age for pig meat production is between 17-22 months (Horwitz 1989). All the fusion and the dental data indicate the same tendency, that pigs were mainly exploited for meat production (Al-Zawahra 2004), and the strategy was to keep the offspring until they reached maximum weights, around 1-2 years. The old females were killed when no longer useful for reproduction. A few pig specimens have marks of butchering, burning or calcination, as well as gnawing marks.

These high ratios of cultural modifications seen in the pig bones indicate food preparation and the exploitation of pigs to provide a protein source for the inhabitants of the site. The high ratio of pigs may reflect the favourable environmental conditions (wooded areas).

All elements of the main domestic mammals are represented, which indicates that the animals were raised and consumed at the site. During the Chalcolithic period in the Levant there was an intensive husbandry of sheep, goats and cattle (Davis 1987; Grigson 1987, 1995).

Molluscs may have been a food source especially *Levantina* and the marine shellfish, which could be eaten close to the coast. Marine shells, both from the Mediterranean and the Red Seas, were found at Tell el-Mafjer. These marine shells were brought to the site for specific purposes: ornaments, decoration, offerings, etc. (Reese 1989). One polished *Phalium* lip was found at the site and may have been used as a personal ornament or offering, as many of these *Phalium* lips are found in graves and sanctuaries (Reese 1989, 1991).

Wild species were also exploited by the inhabitants of the site. They played a very minor role in food production in contrast to the domestic species. Gazelle remains are predominant among the herbivorous wild mammal remains.

Trade

The transport and trade of marine shells (Red Sea/Indo-Pacific) was practiced by peoples in the Mediterranean basin as early as the Epi-Palaeolithic period. Some of these are unmodified, others are made into simple beads, and some are finely engraved or incised (Reese 1991). Marine shells were found in the Natufian, Neolithic, Chalcolithic, Early, Middle, and Late Bronze periods, as well as later periods on many Palestinian sites. In the early periods, Natufian and Neolithic, it is possible that the nomadic and semi-nomadic occupants had access to the sea, and collected and transported these shells to their sites. In the Chalcolithic, Early and Middle Bronze Age and later, shells seem to be the objects of down-the-line or trickle trade, with

either ready-made beads or the raw material being passed on through successive middlemen and exchange (Reese 1991). The presence of the Mediterranean marine shells—*Conus mediterraneus*, *Phalium sulcosum* (Gastropoda), *Glycymeris violascens* and *Cerastoderma glaucum* (Bivalvia)—as well as the Red Sea shell, *Tridacna maxima,* at Chalcolithic Tell el-Mafjer supports the idea of trade and/or exchange by the people of the site. These marine shells were probably imported for ornamental purposes. One lip of *Phalium* shell was recovered, cut and polished in such a way as to be used as personal ornament. A Mediterranean *Conus* shell was found perforated at its apex, and may have been part of a necklace. *Cardium* and *Glycymeris* were also present among the Tell el-Mafjer shells. Biggs (1963) suggests a symbolic meaning for them: the ridged cardium may have represented the sun's rays and the smooth-surfaced *Glycymeris* may have represented the moon deity. The Red Sea shell, *Tridacna maxima*, due to its large size, was used for containers and as raw material for tool and artefact manufacture.

The Nile perch fish bone remains, *Lates niloticus,* were reported on many Palestinian sites (Lernau 1992), although they are not recorded among the Tell el-Mafjer 2002 faunal remains. This species is a typical in the Nile valley, and its presence outside its natural area of distribution indicates trade with that region. The bones of this fish were reported from Middle Bronze II, Iron, and Early Roman contexts at Jerusalem (Lernau 1992). Nile perch bones were found in Late Bronze Age contexts at Tell Abu Hawam (Weinstein 1980), Tel Harasim (Givon 1996), Tell el-Wawiyat (Nakhai *et al*. 1987/1988), and at Sarepta (Baramki 1959). One *Lates* vertebra was found at Tell Jenin, in a Late Byzantine context (Al-Zawahra 1999). On the other hand, Rose (1994) believes that these Nile fish indicate trade, possibly through the Red Sea to the Mediterranean coast. Egypt would have transported its trade commodities to one of the ports along the Mediterranean coast of Palestine (Maher 1997), where goods were then redistributed throughout the Levant from that port. Local maritime trade and exchange cycles and routes of long distance trade were already in existence in the Mediterranean area as early as the Chalcolithic and the Early and Middle Bronze Age (Reese 1991; Rose 1994). Palestinians traded with Egypt and the Mediterranean during the Chalcolithic period either directly or indirectly. These fish remains provide evidence for these trade and exchange activities (Van Neer *et al*. 2004, 2005).

Palaeoecology

The main aim of the environmental reconstruction studies is to understand the relationships between the inhabitants of the site and their environment throughout the various periods of occupation. This understanding can be achieved by establishing the habitat requirements of the species found, especially the micro-fauna, birds, and wild mammals. Large mammals are less sensitive to a change in climatic conditions than micro-species. This is even more the case for domestic mammals, for which human intervention expands the range of tolerance. The remains of wild animals and those of microfauna are very rare at Tell el-Mafjer (2002). The presence of some wild mammals such as *Sus scrofa* and the wild goat *Capra aegagrus* as well as the fallow deer indicate a wooded area ecotype. This area may have been restricted to humid valleys such as Wadi Nuema, Wadi Qelt and the nearby Jordan River. On the other hand, gazelle remains indicate a steppe-like environment; these animals would have been hunted in the wider catchment area of the site.

The high proportions of pig bones could be explained by the moist climate during the Chalcolithic period that enabled them to be raised because of the presence of trees and other thick vegetation cover in the area. As a result, the site would have been suitable for pigs as there was the shade necessary to protect the animals from excessive exposure to the sun (Van Neer, pers. comm.).

CONCLUSION

The inhabitants of Tell el-Mafjer during the Chalcolithic period practiced a settled mode of life dependent on animal husbandry of sheep, goats, pigs, and cattle. Sheep and goats were exploited for their

secondary production of wool, milk and diary products and for their meat when they get older. Pigs were used for meat production, while cattle were exploited for their strength, for plowing, carrying and other agricultural work, as well as for milk. Hunting was a supplementary mode of meat acquisition from nearby areas as well as from the farther catchment areas of the site.

The inhabitants of Tell el-Mafjer during the Chalcolithic period practiced trade or exchange either directly or indirectly with the Mediterranean seacoast and with Egypt. The climate of the site was humid, the precipitation being high enough to support good vegetation cover, thus enabling cultivation and the raising of pigs.

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Species	Specimens	Squares						
		A3	A5	A6	A10	A11	A24	Total
Sus	Pelvis	1	-	-	-	-	-	1
	Femur	-	2*	-	-	-	-	2
	Tibia	-	-	-	-	1	-	1
	Humerus	-	-	-	-	2	-	2
Bos	Talus	2	-	2	-	-	1	5
	Cranium	-	-	1	-	-	-	1
	Humerus	-	-	1	1	-	-	2
	Scapula	-	-	-	-	1	-	1
	Metatarsus	-	-	-	-	1	-	1
Ovis	Talus	1	-	-	-	-	1	2
	Femur	-	-	-	-	-	1	1
Ovis/Capra	Metacarpus	-	1	-	-	-	-	1
	Mandible	-	-	1	1	-	-	2
	Femur	-	-	-	-	1	-	1
	Radius	-	-	-	-	1	-	1
	Pelvis	-	-	-	-	-	1	1
	Humerus	-	-	-	-	-	1	1
Capra	Humerus	-	-	-	-	1	-	1
Total		4	3	5	2	8	5	27

*: One femur with a chopping mark on its shaft.

Appendix A—The bones from Tell el-Mafjer 2002 having cut marks or indications of butchering.

Species	Specimens	Squares						
		A3	A5	A6	A10	A11	A24	Total
Sus	Teeth	1	-	-	-	-	-	1
	Mandible	1	-	-	1	-	-	2
	Tibia	1	-	-	1	-	-	2
	Humerus	-	-	-	1	-	-	1
	Talus	-	-	1	-	-	-	1
	Radius	-	-	-	1	-	-	1
	Ulna	-	-	-	1	-	-	1
	Scapula	-	-	-	-	-	1	1
	Phalanx 1	-	-	-	1	1	-	2
Bos	Radius	-	-	1	-	-	-	1
	Phalanx 1	1	-	-	-	-	-	1
Ovis	Talus	1	-	-	-	-	-	1
	Radius	1	-	-	1	-	-	2
	Ulna	-	1	-	-	-	-	1
Ovis/Cap	Humerus	-	-	-	-	1	-	1
	Mandible	1	-	-	-	-	-	1
	Femur	-	1	-	-	-	-	1
	Phalanx 2	1	-	-	1	-	-	2
	Pelvis	1	-	-	-	-	-	1
Capra	Scapula	1	-	-	2	-	-	3
Gazella	Horn core	1	-	-	-	-	-	1
Mammals	Indeterminate	1	3	1	8	1	1	15
	Vertebra	1	-	-	-	-	-	1
Melanopsis	Shell	-	-	1	1	-	-	2
Total		13	5	4	19	3	2	46

Appendix B—The bones from Tell el-Mafjer 2002 that were burnt or calcined.

Species	Specimens	Squares						
		A3	A5	A6	A10	A11	A24	Total
Sus	Femur	-	-	-	-	-	1	1
Bos	Humerus	-	-	1	-	-	-	1
Total		-	-	1	-	-	1	2

Appendix C—The bones from Tell el-Mafjer 2002 with gnawing marks.

Species	Specimens	Squares						
		A3	A5	A6	A10	A11	A24	Total
Ovis/Capra	Mandible	-	1	-	-	-	-	1
	Metapodial	-	-	-	-	-	1	1
Bos	Talus	-	-	1	-	-	-	1
	Phalanx 1	-	-	1	-	-	-	1
	Ulna	-	-	-	-	1	-	1
Total		0	1	2	0	1	1	5

Appendix D—The bones from Tell el-Mafjer 2002 with signs of pathology.