ARCHAEOBOTANICAL EVIDENCE FOR EARLY NEOLITHIC DIET AND SUBSISTENCE AT M'LEFAAT (IRAQ)

M. SAVARD, M. NESBITT and R. GALE

Abstract : *The archaeobotanical assemblage of the Aceramic Neolithic site of M'lefaat, dated to the beginning of the 10th millennium uncal. BP, is dominated by legumes, especially Vicieae,* Lathyrus/Vicia, Vicia ervilia *and* Lens, *and by grasses, such as* Hordeum spontaneum/distichon, Aegilops cylindrica/tauschii/speltoides *ssp.* speltoides *and* Triticum boeoticum/Secale. *Other taxa such as* Gypsophila pilosa *type and* Bellevalia *type, also count for a significant part of the assemblage. Taxa associated with a riverine environment dominate the charcoal assemblage.*

The archaeobotanical results of other contemporary steppic sites of the northern Fertile Crescent (Qermez Dere, Abu Hureyra, Mureybet and Jerf el Ahmar), were compared to those of M'lefaat. The results are quite similar : legumes, especially Vicia *and* Lens, *and grasses, especially* Hordeum spontaneum/distichon *and* Triticum boeoticum/Secale, *dominate. A distinctive trait of the M'lefaat assemblage is the abundance of* Aegilops. *Although it is impossible to rule out domestication or cultivation, there is no positive evidence for this at the site. Archaeobotanical results from M'lefaat and other steppic sites suggest that wetter conditions and a moist-steppe vegetation and/or forest-steppe, with good availability of grasses, were in place by 10,000 BP.*

Résumé : *Nous présentons ici les résultats de l'étude des restes carpologiques et anthracologiques de M'lefaat, site néolithique précéramique du nord de l'Iraq datant du début du 10e millénaire BP (non calibré).*

L'assemblage carpologique de M'lefaat est dominé par les légumineuses, notamment Vicieae, Lathyrus/Vicia, Vicia ervilia *et* Lens *sp., et par les graminées, notamment* Hordeum spontaneum/distichon, Aegilops cylindrica/tauschii/speltoides *ssp.* speltoides *et* Triticum boeoticum/Secale. *D'autres taxons,* Gypsophila pilosa *et* Bellevalia, *comptent aussi pour une part importante de l'assemblage.*

Les résultats archéobotaniques d'autres sites steppiques du nord du Croissant Fertile de la même époque ont été comparés à ceux de M'lefaat. Les gisements de cette période pour lesquels les restes archéobotaniques ont été préservés et analysés se limitent à Qermez Dere, un site en cours d'étude mais pour lequel nous disposons de résultats préliminaires, à Abu Hureyra, Mureybet et Jerf el Ahmar. Sur tous les sites les assemblages carpologiques et anthracologiques sont assez semblables : les légumineuses, notamment Vicia *et* Lens, *et les graminées, telles que* Hordeum spontaneum/distichon *et* Triticum boeoticum/Secale, *dominent. Les restes carpologiques témoignent de la présence d'une ripisylve et d'une steppe humide et/ou d'une forêt-steppe ; les assemblages anthracologiques sont dominés par des taxons de la ripisylve. L'un des traits qui distingue M'lefaat des autres sites est l'abondance d'*Aegilops.

À l'exception peut-être de Abu Hureyra, la présence des céréales domestiques n'est attestée sur aucun des sites mentionnés. Malgré l'importance de certains taxons qui, de nos jours, sont considérés comme des adventices, il est difficile de prouver l'existence d'une agriculture pré-domestique. Les résultats archéobotaniques semblent indiquer que, vers 10 000 BP, le climat était plus humide et que le paysage végétal était caractérisé par la présence d'une steppe humide et/ou d'une forêt-steppe où abondaient les graminées.

Mots Clefs : *Archéobotanique, Anthracologie, Carpologie, Environnement, PPNA, Néolithique pré-céramique, proto-Néolithique.*
Key-Words : *Archaeobotany, Charcoal, Seeds, Environment, PPNA, Aceramic Neolithic, Proto-Neolithic.*

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The 10th millennium BP[1] is a key period for subsistence and environmental change in the Fertile Crescent of the Near East. Late Epipalaeolithic/early pre-pottery Neolithic roundhouse villages occupied by hunter-gatherers are therefore of great interest. The archaeobotanical remains from such sites give us important insights into subsistence strategies and the relationship between people and their natural environment, forming direct evidence for the vegetation surrounding each site and its use by their inhabitants.

THE SITE OF M'LEFAAT

M'lefaat is located in northern Iraq, about 35 km east of Mosul, and about 260 m from the western bank of the river Khazir (fig. 1). The small tell is flanked by two small valleys, nowadays dry, and was first identified and sounded by R.J. Braidwood in 1954. M. Matti Baba Altun conducted a rescue excavation during the construction of the Mosul-Erbil road in 1984 and Prof. Stefan Karol Kozłowski led two seasons of fieldwork in 1989 and 1990[2].

The 0.5 ha permanent village was occupied by hunter-gatherers at the beginning of the 10th millennium BP (table 1). A least two phases of occupation, not far apart in time, were identified. The inhabitants built semi-subterranean houses made of clay and 10 to 12 of these structures have been found, organised around a central courtyard. The ground stone industry is very similar to that of the contemporary neighbouring sites of Nemrik and Qermez Dere[3], while the flint industry resembles that of Jarmo and Ali Kosh[4]. The zooarchaeological assemblage (composed mainly of gazelle, hare, fox and unidentified ruminants) and the archaeobotanical assemblage presented in this paper reveal that the inhabitants were exploiting the rich and diversified resources of a steppe and/or forest-steppe and the close-by watercourse and riverine environment, with occasional expeditions in the mountains[5].

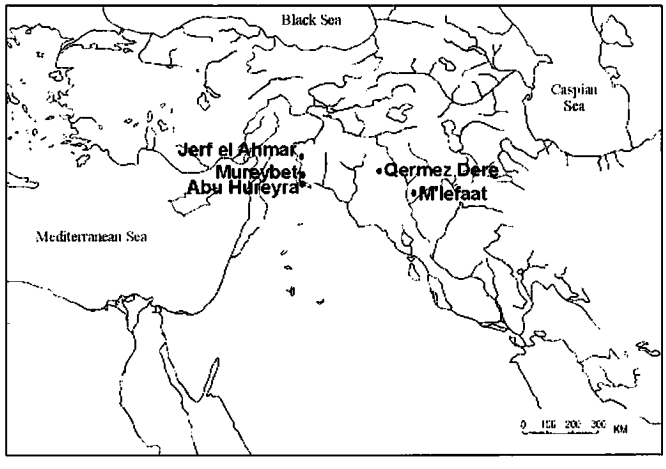

Fig. 1 : *Main sites mentioned in this article (Adapted from BAR-YOSEF and MEADOW, 1995).*

CLIMAX VEGETATION AROUND M'LEFAAT

M'lefaat lies at 314 m above sea level, in the upper plains and foothills of the Upper Jazira District, and is located in the moist-steppe zone, as defined by the *Flora of Iraq*[6]. The vegetation near the site has been completely transformed and the brown soils are likely to have been much impoverished over thousands of years of human activity[7]. The potential vegetation would be characterised by an open savannah dominated by *Pistacia* and other small trees. The annual rainfall, averaging between 350 and 500 mm per annum, could allow winter cultivation without irrigation. Nowadays, protected places of the moist-steppe zone have luxuriant spring grassland dominated by *Poa bulbosa*, *Hordeum bulbosum* and other grasses and herbs such as *Aegilops speltoides* and *Anemone coronaria*[8]. The nearby Jabel Maqlub, a low mountain (1,050 m) rising from the Mosul plain, may have had oak woodlands similar to the present-day forest zone, now located in farther mountain regions, at elevations between 500 and 1,800 m, where annual rainfall lies between 700 and 1,400 mm[9].

Table 1 : *AMS radiocarbon dates BP (uncalibrated) made on lentils (*Lens *sp.) (from KOZLOWSKI, 1998).*

	House 3 (later phase)	House 8 (earlier phase)
Upper fill	OxA 3747 : 9,870 ± 140	OxA 3748 : 9,890 ± 120
Lower fill	OxA 3810 : 9,680 ± 100	OxA 3749 : 9,660 ± 250

1. All dates cited in this paper are in uncalibrated radiocarbon years before present.
2. KOZLOWSKI, 1998 ; KOZLOWSKI *et al.*, 1991.
3. MAZUROWSKI cited by KOZLOWSKI, 1998.
4. KOZLOWSKI, 1999.
5. A complete report on the M'lefaat excavation can be found in KOZLOWSKI, 1998.
6. GUEST, 1966.
7. GUEST, 1966 ; WILLCOX, 2002b.
8. GUEST, 1966.
9. *Ibid.*

THE ARCHAEOBOTANICAL ASSEMBLAGE OF M'LEFAAT

METHODOLOGY

Four samples were taken from two arbitrarily-defined layers, each 20 cm thick, from the fill of two houses : house 3, belonging to the later phase of occupation, and house 8, belonging to the earlier. All samples came from redeposited cultural layers characterised by evenly charcoal flecked soils, with no direct functional link to fire installations or other specific contexts. The samples were floated by M. Nesbitt on the banks of the river Khazir, using a modified "Siraf"-type flotation machine and a petrol pump. Seeds and charcoals were collected using a 0,35 mm mesh while an internal mesh of 1 mm was used for the heavy residues. Sorting and preliminary analysis of the charred seeds and fruits were conducted on sample MT90-4[10]. The sorting and identification of the charred seeds was completed by M. Savard using the reference and seed collections of the G. Pitt-Rivers laboratory (McDonald Institute for Archaeological Research, University of Cambridge) and the reference collection of the Institute of Archaeology (London).

The charred seeds and fruit remains of M'lefaat were in some cases very fragmented but overall relatively well preserved. Most of the fragmentation seems to have occurred after or during charring. Fragments have been converted to a number of complete specimens by visual estimate when they were few, or by comparison of weight with that of complete specimens when many. In the case of unidentified Poaceae and Fabaceae, we used the average weight of all identified taxa for each respective family.

R. Gale analysed the charcoal. The charcoal from the 1 mm light fraction was weighed after the seeds had been sorted and removed. The larger fragments (> 4 mm) were separated from the remainder. Each fragment from the > 4 mm samples and suitable fragments from the smaller fractions were fractured to expose fresh surfaces in the transverse, tangential, and radial planes. These were supported in sand and examined using a Nikon Labophot incident light microscope at a magnification of up to X400 ; the anatomical structures were compared to reference slides of modern wood. Some of the charcoal was in fairly good condition but the distorted structure and rather vitrified appearance of many fragments suggested burning at extremely high temperatures (above 800 °C). In a few fragments, the cell walls had been coated with extraneous substances, which obscured diagnostic details. Samples were identified to genus level or, where anatomically similar taxa occurred, to a type grouping.

10. NESBITT, 1998.

RESULTS

Charred seeds and fruit remains

M'lefaat samples were not rich in seeds and fruits remains : on average, there were only 3 to 4 seeds per litre floated and the seed to charcoal ratio (by weight) varies from 0.07 to 0.14. While figure 2 presents the proportions of the taxa found at M'lefaat, table 2 presents the results in absolute numbers[11]. The M'lefaat assemblage is dominated by Fabaceae (55 %), especially vetches/wild pea (Vicieae tribe, mainly *Vicia/Lathyrus*), lentils (*Lens* sp.) and bitter vetch (*Vicia ervilia*), and by Poaceae (36 %), especially barley (*Hordeum spontaneum/distichon*), and goat-grass (*Aegilops cylindrical/tauschii/speltoides* ssp. *speltoides*). Einkorn/rye (*Triticum boeoticum/Secale*) is also important, especially in house 3 ; otherwise, there is no significant difference in the assemblage composition of the two houses. In any case, with only one structure from each phase, it would be difficult to make any conclusion on changes over time in the plant assemblage. The assemblage also comprises a significant number of Caryophyllaceae (*Gypsophila pilosa* type and *Vaccaria pyramidata*), Liliaceae (*Bellevalia* type) and Boraginaceae (*Lithospermum* cf. *tenuiflorum*).

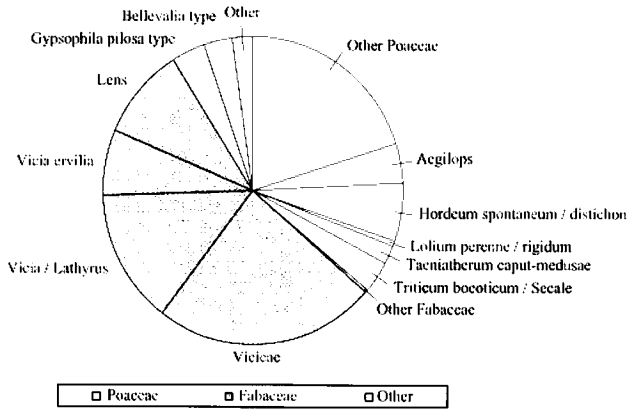

Fig. 2 : *Proportions of the main seed and fruit taxa found at M'lefaat.*

11. In table 2, the volume of sediments taken is the size of the sample that was floated ; the total weight of seeds includes complete specimens and fruit and seeds fragments.

Table 2 : *M'lefaat charred seeds and fruits (in absolute numbers). In this table the term seed includes seeds, caryopses, fruits and nuts.*

Sample	MT90-1			MT90-2			MT90-3			MT90-4			TOTAL
Volume of sediment taken (L)	612			360			240			240			1,452
Volume of flot before sorting (ml)	215.70			96.60			119.10			129.70			561
Total weight of charcoal (g.)	78.46			32.78			40.29			48.32			200
Total weight of seeds (g.)	7.14			2.57			4.32			6.50			21
Total number of seeds	1.983			751			773			934			4,441
Sample location	Upper fill of west part of house 3			Lower fill of west part of house 3			Upper fill of house 8			Lower fill of house 8			TOTAL
Taxa	Complete	Frag. ≈ complete	Total	Complete	Frag. ≈ complete	Total	Complete	Frag. ≈ complete	Total	Complete	Frag. ≈ complete	Total	
Poaceae		318	318		145	145		185	185		169	169	817
Aegilops cylindrica/tauschii/speltoides	14	20	34	7	11	18	17	44	61	27	45	72	185
Hordeum spontaneum/distichon	18	92	110	4	32	36	4	46	50	6	67	73	269
Lolium perenne/rigidum		15	15				1		1	1		1	17
Taeniatherum caput-medusae		30	30		19	19		20	20		22	22	91
Triticum boeoticum/Secale	62	7	69	34	26	60	4		4	6		6	139
Indeterminate Poaceae	7	19	26		10	10		9	9	4	1	5	50
Aegilops spikelet base	3	14	17	3	4	7	4	27	31	11	22	33	88
Aegilops chaff		many			few			many			many		
Fabaceae	7		7		2	2	3		3		1	1	13
Vicieae	2	645	647		61	61		139	139		183	183	1,030
Vicia/Lathyrus	133	43	176	19	114	133	14	136	150	11	153	164	623
Vicia ervilia	124	12	136	61	16	77	26	6	32	42	10	52	297
Lens sp.	195	17	212	59	12	71	30	19	49	62	30	92	424
Trifolieae/*Astragalus*	4	2	6				1		1	1		1	8
Pistacia nutshells		1	1		1	1		1	1				3
Centaurea type	1	3	4					1	1	1		1	6
Gundelia tournefortii	3	2	5										5
Lithospermum cf. *tenuiflorum*	16	3	19				4		4	4	1	5	28
Heliotropium sp.										2		2	2
Gypsophila pilosa type	73		73	60		60	8		8	17		17	158
Vaccaria pyramidata	6		6	3	1	4	4		4	3	1	4	18
Chenopodiaceae	2		2	8		8	5		5	7	1	8	23
Bolboschoenus maritimus type	1		1										1
Bellevalia type	41	25	66	17	13	30	6	7	13	13	10	23	132
Rumex sp.	1	1	2	5	1	6	1		1				9
Adonis flammea type	1		1	2	1	3	1		1				5
Amygdalus/Prunus nutshells		presence						presence					
Feaces													
Pod	1												
Bud base?				3		3							
Nutshells ?					very few			very few			very few		
Indeterminate	4	many		2.00	many		1	very few		3.00	few		
Indeterminable		many			very few			many			few		
Total number of seeds	714	1,269	1.983	282	469	751	133	640	773	218	716	934	4,441

Identification criteria

The identification criteria for each taxon identified are presented here in three groups : grasses (Poaceae), legumes (Fabaceae) and the other seed and fruit remains in alphabetical order of family.

- Poaceae (Gramineae)

Several Poaceae taxa have been identified. We found no morphological evidence of domestication.

– *Aegilops cylindrica/tauschii/speltoides* ssp. *speltoides* (fig. 3-c)

Goat-grass caryopses were easily recognised by their flat ventral side and a low-domed dorsal side. Some of their robust spikelet bases and veined glumes have also been preserved. The size of the barrel-type spikelet bases suggests *Ae. cylindrica/tauschii/speltoides* ssp. *speltoides*. The variability observed in the specimens of both M'lefaat and of the reference collection did not allow us at present to distinguish between the three species, even with chaff. A more reliable criterion would be the tips of glumes, but these parts have not been preserved. *Ae. cylindrica* is nowadays very rare in Iraq and is found in denuded or cleared oak forest, on stony hillside. *Ae. tauschii* is nowadays locally frequent in the steppe regions and sub-dessert zone. It is found on grassy steppic slopes, in silty or sandy desert depressions, and as a weed in disturbed or cultivated land[12]. As for *Ae. speltoides* ssp. *speltoides*, it is common in the moist-steppe zone and still present nowadays in protected parts of the area.

– *Hordeum spontaneum/distichon* (fig. 3-a)

Barley caryopses have a flat dorsal side, are relatively thin, especially around the apex, and have a shallow but large ventral furrow. The species can be grouped by size. The M'lefaat specimens were too large and too thick to belong to the small barleys such as *H. murinum* or *H. bulbosum* and were therefore identified to the *Hordeum spontaneum/distichon* group. As the grain sizes of wild barley (*H. spontaneum*) and of domesticated barley (*H. distichon*) overlap, identification to species by grain alone is not usually possible[13]. An attempt to distinguish them was made by measuring the breath and thickness of the 164 M'lefaat measurable specimens (fig. 5), and by comparing these data to measurements from Jordanian and Syrian sites of the same period[14]. While more than 1/3 of our specimens could belong to the wild barley category and about 1/5 to the "domesticated" category, most of our specimens fall in the overlapping size category (fig. 5). No definite statement about the domestication status of the M'lefaat grains is therefore possible.

– *Lolium perenne/rigidum* (fig. 3-d)

Ryegrass caryopses have a relatively flat ventral side and a slightly domed dorsal side. Both the upper and lower ends are tapered. The scutellum is V-shaped. Some specimens still have parts of the punctate lemma and palea adhering. All six Old World species can be found in Iraq. They have a varied distribution : they can occur in the desert regions, in alluvial plains, in the dry or moist-steppes and in the forest zone. According to their size, three groups of *Lolium* can be identified. The specimens of M'lefaat are rather small and are very similar to *L. perenne*, *L. rigidum* and *L. multiflorum*. The latter being very uncommon in the region, we have identified our specimen as *L. perenne/rigidum*.

– *Taeniatherum caput-medusae* (fig. 3-e)

Fragments of *Taeniatherum* caryopses are distinctive with their flat dorsal side, their wide V- or U-shaped ventral furrow and their sharply demarcated lateral grooves. The only two sub-species, *crinitum* and *asperum*, occurring from the Mediterranean to North-west India, are found in Iraq. Both are nowadays found in the forest-steppe and steppe region of Iraq and used as forage. No attempt was made to identify them to the sub-species level.

– *Triticum boeoticum/Secale* (fig. 3-b)

Even if eroded, wild einkorn (*Triticum boeoticum*) caryopses are recognizable : in lateral view, the ventral side is slightly curved, and the caryopses are laterally compressed, resulting in a high but straight dorsal ridge. The grains of wild rye (*Secale*) are very similar, and no attempt has been made to distinguish them. We have included in the group some atypical specimens that are very similar to the Triticoid type identified at Ganj Dareh[15]. In ventral view, they are characterised by a drop shape, tapered towards the proximal end, and wide and round at the apex. In lateral view, the ventral side is usually slightly rounded while the dorsal side is flat or rounded. Their different appearance is likely to be due to carbonisation[16].

12. TOWNSEND *et al.* (eds), 1968.
13. VAN ZEIST and BAKKER-HEERES, 1982 ; personal observation of the authors and of George Willcox.
14. COLLEDGE, 2001.
15. VAN ZEIST *et al.*, 1984.
16. G. Willcox, pers. comm.

Fig. 3 : *Poaceae found at M'lefaat.*

a. *Hordeum spontaneum/distichon*, caryopses ; b. *Triticum boeoticum/Secale*, caryopses ; c. *Aegilops cylindrica/tauschii/speltoides*, spikelet base and caryopses ; d. *Lolium perenne/rigidum*, caryopses ; e. *Taeniatherum caput-medusae*, caryopses fragments.

T. boeoticum is nowadays commonly found in the lower forest zone of Iraq, in grassland on lower limestone mountain slopes and in degraded oak forest or schrub. Both subspecies, ssp. *boeoticum* and ssp. *thaoudar* have similar distributions[17]. As for *Secale*, there are now two wild species in Iraq : *S. montanum*, which is common in the upper forest zone of Iraq, on dry stony or rocky mountainsides and sometimes under light oak forest, and *S. afghanicum*, rare in Iraq, but found in silty depressions under oak[18].

- Fabaceae

At least five legume taxa have been identified, but the large quantity of burnt legume endosperm fragments belonging to the Vicieae tribe have been impossible to identify with more precision. A large number of vetches have been found (*Vicia/Lathyrus*). The M'lefaat specimens attributed to these genera are rounded to sub-oval and are generally poorly preserved and lack the hilum. Because these genera comprise a large number of species extremely variable in size and shape, a more precise identification has proven to be difficult. Bitter vetch (*Vicia ervilia*) has been easily identified, with its distinctive angular to rounded outline and triangular cross-section (fig. 4-j). Lentils (*Lens* sp.) are easily recognized by their circular outline with a sharp margin and their flatness (fig. 4-i). *Astragalus* sp., *Trigonella* sp. and *Medicago* sp. are difficult to differentiate and have, for the present, been put in a small-seeded legumes category (Trifolieae/*Astragalus*).

- Other families

– *Anacardiaceae*

Terebinth (fig. 4-k) nutshell and fragments are thin (about 1 mm), have a smooth surface on the outside, and may have

17. TOWNSEND *et al.* (eds), 1968.
18. *Ibid.*

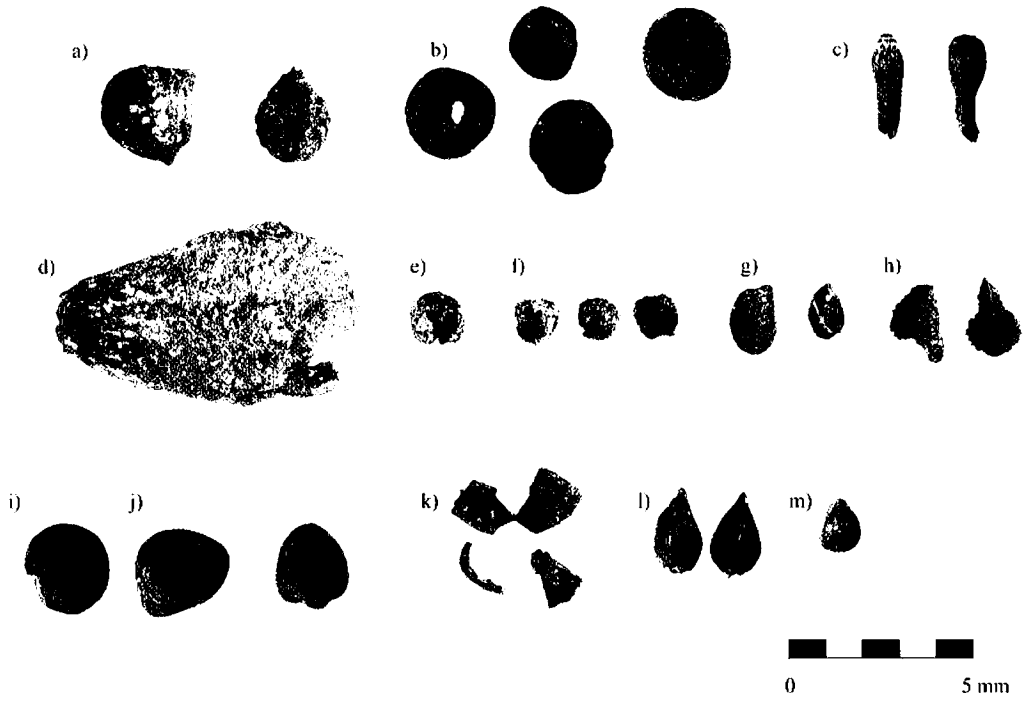

Fig. 4 : *Main taxa (except Poaceae) found at M'lefaat.*

a. *Adonis flammea* type ; b. *Bellevalia* type ; c. *Centaurea* type ; d. *Gundelia tournefortii* ; e. *Vaccaria pyramidata* ; f. *Gypsophila pilosa* type ; g. *Heliotropium* sp. ; h. *Lithospermum* cf. *tenuiflorum* ; i. *Lens* sp. ; j. *Vicia ervilia* ; k. *Pistacia* sp., nutshell fragments ; l. *Rumex* sp. ; m. *Bolboschoenus maritimus* type.

traces of fruit flesh inside. No whole nuts were found. Nowadays, there are two wild species in Iraq : *Pistacia khinjuk* and *P. eurycarpa*. The species are common to the forest zone of Iraq and occasional in the forest-steppe transition[19].

– *Asteraceae (Compositae)*

A few poorly preserved *Centaurea* type achenes have been encountered (fig. 4-c). In most cases, the pappus rim was badly eroded or broken but had the oblong outline and the compressed side typical of *Centaurea*[20]. However, in both cases, since only small apex fragments have been recovered, we have preferred to use the determination *Centaurea* type. A few almost complete specimens and fragments of the capitulum of *Gundelia tournefortii* have been found (fig. 4-d) ; it is a distinctive fruit with a woody and fibrous capitulum containing an oil-rich achene, native of the steppe but also occurring in open woodland[21].

– *Boraginaceae*

Two Boraginaceae taxa were found at M'lefaat : *Lithospermum* cf. *tenuiflorum* (fig. 4-h) and *Heliotropium* sp. (fig. 4-g). *Lithospermum* have a silicified surface and most were uncharred. It is therefore difficult to say whether they are intrusions or archaeological specimens, particularly as they are abundant in the archaeobotanical assemblage. The nutlets are obliquely ovate, have a truncated base and a pointy apex. The specimens of M'lefaat have a distinctive wart-like surface, have prominent humps on both sides and a relatively small triangular base[22]. They resemble the species *L. tenuiflorum* illustrated in van Zeist and Bakker-Heeres[23] and found in the Institute of Archaeology's (London) reference collection. *L. tenuiflorum* is commonly found in fields and among steppe vegetation. *Heliotropium* specimens are recognizable by their compressed nutlets with a rugulose surface. *Heliotropium* species are found in steppic environment and as a weed of dry land cultivation.

19. GUEST, 1966.
20. VAN ZEIST and BAKKER-HEERES, 1985.
21. ROSENBERG *et al.*, 1995, 1998.
22. VAN ZEIST and BAKKER-HEERES, 1982.
23. *Ibid.*

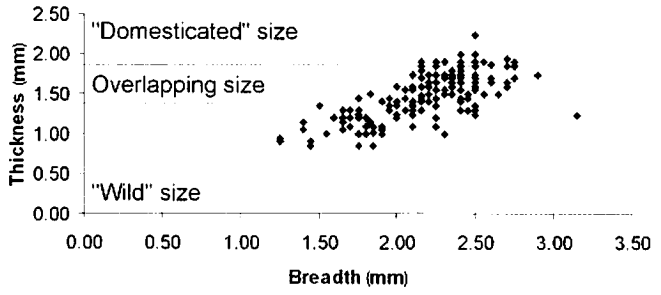

Fig. 5 : *Breadth and thickness of the M'lefaat barley (*Hordeum spontaneum/distichon*) specimens.*

The chart presents the size of the barley specimens of M'lefaat while the lines are the approximate limits of the wild and domesticated type identified by S. Colledge (2001) at Late Epipalaeolithic/Early Neolithic sites of Jordan and Syria.

– *Caryophyllaceae*

Two taxa belonging to the Caryophyllaceae family have been identified : *Gypsophila pilosa* type (fig. 4-f) and *Vaccaria pyramidata* (fig. 4-e). The *Gypsophila* specimens were identified by the densities of plates and papillae and the organization of cells. *Gypsophila* has small reniform seeds with compressed side-faces, covered with elongated plates with a raised central papilla[24]. The surface structure of the M'lefaat specimens is consistent with the *G. pilosa* specimen in the Institute of Archaeology's reference collection. *Gypsophila* is found in steppes, in cultivated fields, on roadsides, on slopes and gravel banks. The second taxon, *Vaccaria pyramidata*, has globular seeds covered with tiny distinctive papillae. The seeds tend so split in two halves during carbonisation[25]. No attempt was made to identify them to sub-species. They are found in cultivated fields and in steppes.

– *Chenopodiaceae*

Chenopodiaceae seeds are circular with a notch at the radicule. The M'lefaat assemblage is likely to contain two or more taxa. Because of their shiny surface and radial striations, some specimens could possibly be attributed to *Chenopodium sp.* However, since it is a very large family and only a few damaged specimens were found, no attempt was made to identify them with more precision. Many of the Chenopodiaceae genera are shrubby and are often found in steppe, including dry steppe, and in cultivated lands and roadsides.

24. BERGGREN, 1981.
25. VAN ZEIST and BAKKER-HEERES, 1982.

– *Cyperaceae*

One specimen of *Bolboschoenus* has been recognized by its obovate nutlets, tapering towards the base, its flat ventral side and the rounded median ridge on its dorsal side. Our specimen is very similar to those identified in van Zeist and Bakker-Heeres[26]. However, because there are a large number of species that are hard to distinguish, we have preferred the determination *Bolboschoenus maritimus* type (fig. 4-m). *Bolboschoenus maritimus* is found in fresh-water swamps, at the sides of rivers and streams, and in more or less saline habitats.

– *Liliaceae*

A large number of Liliaceae seeds have been found. They are almost globular, sometimes irregularly shaped. Carbonised seeds such as these have a hole running from the apex to the base[27] while in a few specimens, the remains of the embryo are visible in the hole. They match the description and drawings of *Bellevalia* in van Zeist and Bakker-Heeres[28]. Moreover, in some of the broken specimens of M'lefaat, one can see radial striations around the hole in vertical cross-section. The reference material presents the same radial pattern in section. Nevertheless, because the Liliaceae family is very large, we have preferred the determination *Bellevalia* type (fig. 4-b). Some species of *Bellevalia* (*B. ciliata* and *B. trifoliate* for example) occur as weeds in fields[29].

– *Polygonaceae*

A few triangular seeds have been identified to *Rumex* sp. (fig. 4-l). They are three-sided, have a large base, a pointy apex and ridged edges. *Rumex* are found in disturbed habitats and in damp places[30].

– *Ranunculaceae*

Five *Adonis* nutlets have been recovered. They are bi-convex, almost circular, with a keel margin, a rugose-reticulate surface and a pattern of prominent ribs[31]. They are very similar in shape and size to the *A. flammea* of the Institute of Archaeology's reference collection and we have therefore identified the M'lefaat specimens as *A. flammea* type (fig. 4-a). Some *Adonis* species are common weeds in fields[32].

26. *Ibid.*
27. *Ibid.*
28. *Ibid.*
29. *Ibid.*
30. DAVIS (ed.), 1965-1988.
31. VAN ZEIST and BAKKER-HEERES, 1982.
32. *Ibid.*

– *Rosaceae*

A few fragments of nutshells very similar to almonds have been identified. Almond nutshells are distinctive in cross-section with their sandwich-like layers, their thick wall, and their pitted and grooved surface. Well-preserved fragments are easily identified, but our few nutshells fragments were very eroded, so we have preferred the determination *Amygdalus/Prunus*.

• Other material found

A possible pod fragment and a bud base have been found. Those, along with the indeterminate and indeterminable plant material, have not been included in the total of each sample and in the total of the score sheet. Further analyses may allow us to identify them with more precision.

CHARCOAL ANALYSES AND THE ENVIRONMENT OF NEOLITHIC M'LEFAAT

Table 3 presents the results of the charcoal analyses of M'lefaat. Six taxa were identified : maple (*Acer*), ash (*Fraxinus*), oak (*Quercus*), terebinth (*Pistacia*), willow/poplar (*Salix/Populus*[33]) and tamarisk (*Tamarix*). Both houses yielded the same species.

Although significant quantities of charcoal were collected, only two structures belonging to two building phases were represented. Reconstructions of the landscape should, therefore, be regarded as a framework into which future work can be incorporated rather than as a definitive list of local woody taxa. Those identified suggest that the diversity of species was greater than it is today.

Gillet[34] suggests that, as moist-steppe, this region was once lightly wooded with terebinth (*Pistacia*) and other small trees and shrubs. The identification of terebinth and tamarisk (*Tamarix*) from M'lefaat is consistent with this view and, in conjunction with similar results from Qermez Dere[35], suggests that current-day zones of potential vegetation had become established by 10,000 BP.

Deciduous oaks are distinguished from evergreen species by the ring porous arrangements of earlywood vessels, by their conspicuous growth rings and by vessel to ray pitting alternate, rarely square, elongated or triangular. In opposition, evergreen species have diffuse porous structure, inconspicuous growth rings and vessel to ray pitting simple, oval to scalariform, often axially orientated[36]. The oak charcoals from M'lefaat were from deciduous trees and included heartwood ; one piece measured 15 mm and included 15 growth rings. Even allowing for shrinkage during charring, which can be up to 40 % in some species, the tree of origin was evidently extremely slow-growing. This type of growth can often be attributed to edaphic and climatic conditions such as heavily leached soils starved of nutrients, exposure to harsh temperatures, and/or arid conditions. Guest[37] records that whereas there is usually a fairly abrupt boundary between the forest zone and tree-less steppe, a belt of woodland also occurs, dominated by stunted oaks ; the presence of these trees in the assemblage may represent this environment.

The proximity of the site to the river Khazir almost certainly provided access to riverine species such as willow (*Salix*) and/or poplar (*Populus*), ash (*Fraxinus*) and probably tamarisk (*Tamarix*). Maple (*Acer*) may also have been growing in a more humid environment along the course of the river. In such an environment, these taxa are relatively fast growing and, when regularly felled, they regenerate faster than shrubs/trees growing on the more arid steppe, as, for example, terebinth (*Pistacia*) and drought tolerant and xerophytic species of tamarisk (*Tamarix*).

Both ash (*Fraxinus*) and maple (*Acer*) are absent from the region today and evidence of their use as fuel at M'lefaat is of great interest. The relatively frequent occurrence of ash (*Fraxinus*) in the deposits, as compared with oak (*Quercus*) and maple (*Acer*) suggests that it was more easily accessible. *Fraxinus angustifolia* and *F. excelsior* occur in the Near East today[38]. The latter is mainly confined well to the north of Iraq, in the Caucasus and to the edge of the Black Sea, though an isolated community is recorded close to the Mediterranean, on the Syrian/Turkish border. *F. angustifolia* (narrow-leaved ash) has a much wider distribution, including the Taurus mountains in regions to the north and northeast of M'lefaat. There are numerous geographically grouped subspecies that vary in drought tolerance. As a component of open riverine forest, it grows in association with maple (*Acer*), willow (*Salix*), oak (*Quercus*) and other taxa.

Although several species of maple (*Acer*) are recorded in the southern Caucasus and in eastern Turkey, few extend as far south as the Kurdish mountains and, of these, most are rare or their presence is unconfirmed[39]. *A. monspessulanum*, however, has a much wider distribution in the Kurdish mountains

33. Identified as Salicaceae in table 3.
34. Cited by GUEST, 1966.
35. R. Gale's report cited *in* WATKINS *et al.*, 1991.
36. GALE and CUTLER, 2000.
37. GUEST, 1966.
38. BROWICZ and ZIELINSKI, 1990.
39. *Ibid.*

Table 3 : *M'lefaat charcoal analysis results.*

Sample	Fraction	Weight	House Fill	Taxa					
				Acer	*Fraxinus*	*Quercus*	*Pistacia*	Salicaceae	*Tamarix*
MT90-1	> 4 mm	2.6 g	3 Upper				?3	14	9 + ?3
MT90-1	> 1 mm	6.2 g			5	1		12	2 + ?1
MT90-2	> 4 mm	0.8 g	3 Lower	7	6		?2	13	1
MT90-2	> 1 mm	2.6 g			5			8	3
MT90-3	> 4 mm	1.4 g	8 Upper		3		1	6	8
MT90-3	> 1 mm	3.7 g						3	2
MT90-4	> 4 mm	2.0 g	8 Lower	3	6	1	5	5	10
MT90-4	> 1 mm	3.4 g			2	1		3	7

of Iraq and Iran, where subspecies include the most xerophytic of the genus. It is characteristic of xerophytic shrub communities and open conifer and oak forests. At M'lefaat, the paucity of oak and maple in the charcoal assemblage tends to suggest that these species were infrequent (or absent) in the riverine context from which much of the fuel appears to have been gathered, and probably grew in a more arid location, consistent with their ecological preferences.

The abundance of ash, willow/poplar and tamarisk suggests that the nearby river terraces probably supported strips of woodlands providing the main source of fuel and timber ; additional supplies of these resources may have been obtained from the more arid and exposed soils of the moist-steppe from slower growing but nonetheless valuable economic species, such as oak, maple and pistachio, or from forests extending from the Jebel Maglub.

Assuming the landscape was less intensively exploited at the time the site was occupied, woodland resources may have been plentiful, allowing the exploitation of primary forest/ woodland. The apparent abundance of riverine species suggests that additional fuel supplies would not have been necessary, unless a taxon was specifically sought.

FOOD REMAINS IN RELATION TO ENVIRONMENT

The M'lefaat food-plant assemblage is dominated by legumes and grasses while fruits and nuts are not well represented. Its distinctive trait is the abundance of *Aegilops* grains and chaff and the presence of the grass *Taeniatherum caput-medusae*. The abundance of *Aegilops* grain in the assemblage suggests that it was an important food resource. The presence of *Aegilops* chaff, which is inedible, suggests that the grass remains may derive, at least in part, from processing of the harvest to produce clean grain. Another characteristic of the M'lefaat assemblage is the abundance of Caryophyllaceae (especially *Gypsophila pilosa* type) and Liliaceae (*Bellevalia* type). The role of these seeds is more uncertain ; as typical steppe plants, they may well have been inadvertently harvested alongside grasses and pulses, and separated during food processing. In contrast, the capitula of *Gundelia tournefortii* were surely harvested for their oil-rich achenes. *Gundelia* is a large tumbleweed, unlikely to have been harvested alongside wild pulses or grasses. Burnt capitula were found in pure deposits at the contemporary site of Hallan Çemi, southeast Turkey, where they were probably accidentally charred during extraction of the achenes[40].

Overall the grasses account for 36 % of the M'lefaat seeds, and large-seeded pulses for 54 % (fig. 2). In the light of these figures, we postulate that wild grasses and pulses dominated the plant-based component of diet at M'lefaat. The M'lefaat assemblage may not be representative of the full range of plants consumed, as a multitude of factors, including plant processing and taphonomy, influence the composition of an archaeobotanical assemblage. Ethnographic evidence suggests that wild leafy greens, stems and tubers would have been important resources, but these are difficult to detect in charred material.

The environmental significance of the M'lefaat seed remains depends in part on whether they derive from gathering of local plants, or from cultivation. Even if, as we suspect, only wild plants were in use at M'lefaat, some of these may

40. ROSENBERG *et al.*, 1995.

have been cultivated and may have been introduced from elsewhere. Pre-domestication cultivation of wild plants has been widely proposed for sites of this period, but the seed assemblage recovered from M'lefaat is too scanty to test this hypothesis. However, given the evidence, from the wood charcoal, that M'lefaat was already in a moist-steppe and/or forest-steppe at 10,000 BP, the documented food plants could have been gathered locally.

The goat-grass identified at M'lefaat could be *Aegilops speltoides*, which is abundant in the moist-steppe zone in a variety of habitats, as is wild barley (*Hordeum spontaneum*). Wild einkorn (*Triticum boeoticum*) is more restricted to the lower forest zone of Iraq to the North, but is recorded from one of the rocky outcrops in the moist-steppe, in the Jebel Sinjar[41]. Wild rye, (*Secale montanum*), is recorded only from the upper forest zone. Thus, it is likely that the main wild grasses could have been gathered locally. As for the pulses, bitter vetch is restricted to elevations above 800 m, in the forest zone, but wild lentils occur in both the forest zone and the moist-steppe. The unidentified *Vicia* and *Lathyrus* seeds could easily derive from moist-steppe habitats, as could *Bellevalia* and *Gypsophila*.

In principle, then, many of the M'lefaat food plants could have been gathered locally, if our conclusions regarding the early establishment of a *Pistacia* moist-steppe are well founded. A relatively narrow suite of plants is evidenced, with legumes and grasses accounting for 91 % of the recovered seeds. How does this assemblage compare with other steppic sites in the region, and can it throw any light on the position of bitter vetch and wild einkorn/rye at the site ?

M'LEFAAT IN ITS REGIONAL CONTEXT

SITES

Contemporary sites in the steppe zone of the northern Fertile Crescent that have yielded plant remains are very scarce and limited to the following sites : Abu Hureyra[42], Mureybet[43] and Jerf el Ahmar[44], three Euphrates sites that have been flooded by the Tabqa and Tishrin dams, and Qermez Dere[45], for which the archaeobotanical assemblage is currently under study (fig. 1).

Abu Hureyra is located at the junction of the steppe and the then-dense riverine forest. Extensive sampling in the 1970s yielded an impressively large and diverse archaeobotanical assemblage[46]. Abu Hureyra I, the earliest level, was occupied from 11,500-10,000 BP. At Tell Mureybet, excavated in 1964-1965 and 1971 to 1974, four phases dating between *ca.* 10,200 and *ca* 9,500 BP were identified. Phases I to III, which yielded hearths and/or round houses made of clay, are considered by us in this research[47]. The site of Jerf el Ahmar was excavated from 1995 to 2000, and dates to 9,800-9,100 BP. Seven building phases have been identified, allowing the study of the evolution of the round house toward the later PPNB rectangular structures[48]. Qermez Dere is located in northern Iraq, along the flanks of the Jebel Sinjar foothills, about 50 km west of Mosul. In excavations from 1987 to 1990, two phases were identified, dating between 10,150 and 9,600 BP, and characterized by round houses organised around a central area[49].

SUBSISTENCE AND ENVIRONMENT

Barley (*Hordeum*) and wild einkorn wheat/rye (*Triticum* (diploid)/*Secale*) were the main wild grasses found at all the sites[50]. Only in one case, the controversial domesticated rye from Abu Hureyra I, have domesticated grains been found. Other grasses, including small-grained barley (*Hordeum murinum* group), ryegrass (*Lolium*) and feathergrass (*Stipa*) were also an important part of most assemblages. Charcoals indicate that all sites were close to a watercourse, which undoubtedly played an important role in the choice of a site to establish a permanent village. Fuel came mainly from its riverine environment while food-plants were gathered in the riverine environment as well as in the other surroundings. Except for the abundance of *Aegilops* and for the presence of *Taeniatherum*,

41. GUEST, 1966.

42. MOORE *et al.* (eds), 2000 ; ROITEL, 1997 ; WILLCOX, 2002b.

43. VAN ZEIST and BAKKER-HEERES 1984 ; WILLCOX, 1991, 1996, 1999, 2000, 2002b ; WILLCOX and ROITEL, 1998.

44. ROITEL, 1997 ; WILLCOX, 1996, 1999, 2000, 2002a, b ; WILLCOX and ROITEL, 1998.

45. WATKINS (ed.), 1995 ; WATKINS and BAIRD, 1987 ; WATKINS *et al.*, 1989.

46. HILLMAN *et al.*, 1989 ; MOORE *et al.* (eds), 2000.

47. VAN ZEIST and BAKKER-HEERES, 1984.

48. STORDEUR, 2000.

49. WATKINS (ed.), 1995 ; WATKINS and BAIRD, 1987 ; WATKINS *et al.*, 1989.

50. Only preliminary analyses have been conducted at Qermez Dere and no full list of Poaceae nor proportions are available yet. For a full review of grasses at these other sites, see NESBITT, 2002.

Table 4 : *Charcoal taxa found at Qermez Dere, Abu Hureyra 1, Mureybet and Jerf el Ahmar.*

Charcoal taxa		Qermez Dere	Abu Hureyra 1	Mureybet	Jerf el Ahmar
Anacardiaceae	*Pistacia*	**	*	p	**
Betulaceae	*Alnus*		*		*
Betulaceae	*Betula*				
Chenopodiaceae		**	*	p	*
Fagaceae	*Quercus* (deciduous)		*	p	**
Mimosaceae	cf. *Prosopis farcta*		*		
Oleaceae	*Fraxinus*		***		****
Platanaceae	*Platanus*				*
Poaceae	*Phragmites*		**		*
Rhamnaceae	*Rhamnus*		*		*
Rosaceae	*Amygdalus*		*	p	****
Rosaceae	*Prunus cerasus/Prunus*		*		p
Salicaceae	*Populus euphratica*		****		****
Salicaceae	*Salix, Salix/Populus*		****	p	***
Tamaricaceae	*Tamarix*	****	***	p	****
Ulmaceae	*Ulmus*		*		
Vitaceae	*Vitis sylvestris*		*		p

p indicates the presence of a taxa when only qualitative data were available ; * to *** indicates the relative abundance of each taxa when quantitative data were available. Compiled from R. Gales's reports and from VAN ZEIST and BAKKER-HEERES, 1984 ; MOORE *et al.* (eds), 2000 ; ROITEL, 1997 ; WILLCOX, 1991, 1996, 2002b ; WILLCOX and ROITEL, 1998.

the M'lefaat assemblage is similar to the ones found at other contemporary steppic sites. It is, however, markedly less diverse, perhaps because it derives from only two contexts.

Issues similar to those of M'lefaat arise at these sites regarding the local availability of "wild cereals" : were they locally gathered, or did they derive from cultivated or imported gathered material ? Secure evidence (from chaff remains) for wild rye at Mureybet and Jerf al Ahmar, in ecological zones broadly similar to that of M'lefaat, either points to wetter conditions in the 10th millennium BP, allowing this moisture-loving grass to extend much further south, or its importation from the forest zone of the mountains.

Vetches (*Vicia*) and lentils (*Lens*) were the main pulses identified. Fruits and nuts other than terebinth nuts (*Pistacia*), are not well represented. Bitter vetch is present at all four comparable sites, suggesting that it may, if locally gathered, have had a more extensive natural range than today. Although evidence for increased moisture levels is inconclusive, there is good agreement from charcoal[51] and seeds, from all these sites, for established forest-steppe vegetation, characterised by the presence of *Pistacia* and the availability (at, or relatively near, the site) of grasses and legumes.

The presence of wild einkorn/rye and bitter vetch, which are today mainly restricted to the higher-elevation forest zone, is consistent with the view that moisture levels were higher in the period immediately after about 10, 000 BP than in the current day[52]. Both higher moisture levels and the absence of heavy grazing by domesticated animals could have allowed wild einkorn/rye and bitter vetch to grow in the moist-steppe zone, from which they are absent today. Riverine taxa dominate the charcoal assemblages, indicating that all sites had access to riverine vegetation, which was probably denser and richer than it is today[53].

DOMESTICATION

Although we are unable to exclude domesticated status for the M'lefaat barley, there is no secure evidence for domesti-

51. See table 4 and Roitel's 1997 conclusions.

52. MOORE *et al.* (eds), 2000.

53. ROITEL, 1997.

cated plants at the other contemporary steppe sites[54], and only questionable evidence for domesticated plants at any site before 9,500 BP[55]. We therefore consider M'lefaat and the contemporary sites to be pre-agrarian.

Whether cultivation was practised at M'lefaat or elsewhere remains an open question. Recent research has focused on weeds and the use of multivariate statistical analyses to reveal pre-domestic agriculture[56]. Indeed, plants that are nowadays considered weeds of arable fields are sometimes used as an indirect evidence. Some of these plants, such as *Adonis*, *Arnebia*, *Astragalus*, *Bellevalia*, *Bromus*, *Buglossoides*, *Lepidium*, *Polygonum*, Trifolicae, Vicieae, and small seeded *Hordeum*, are quite abundant at several sites. Found in association with wild progenitors of domesticated cereals, they may support an argument in favour of pre-domestic agriculture[57]. However, for the sites presented in this article, the results are not conclusive as these taxa are part of the natural vegetation ; botanical fieldwork conducted in the Syrian steppe after a particularly wet winter showed that these plants could be quite abundant in the wild[58]. In any case, they may have been collected and considered useful resources.

The study of the M'lefaat material forms part of a larger study of plant remains from this and three contemporary sites, Qermez Dere, Hallan Çemi and Demirköy, located along an ecological transect. This research will involve more detailed comparisons between contemporary sites. A key research question is whether the variability in seed remains between sites in the northern Fertile Crescent can be explained in terms of differing environments, or whether other factors such as taphonomy or subsistence systems better explain these differences.

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54. Except maybe, as mentioned above, the controversial domesticated rye at Abu Hureyra I, MOORE *et al.* (eds), 2000.

55. NESBITT, 2002.

56. COLLEDGE, 1998 ; 2001.

57. WILLCOX, 1996 ; WILLCOX and ROITEL, 1998.

58. HILLMAN *et al.*, 1989.

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