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Macro-botanical evidence for plant use at Neolithic Çatalhöyük, south-central Anatolia, Turkey

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Abstract. Analysis of charred plant macro-remains, including wood charcoals, cereals, seeds, tubers and fruits from the Neolithic site of Çatalhöyük has indicated complex patterns of plant resource use and exploitation in the Konya plain during the early Holocene. Evidence presented in this paper shows that settlement location was not dictated by proximity to high quality arable land and direct access to arboreal resources (firewood, timber, fruit producing species). A summary of the patterns observed in sample composition and species representation is outlined here together with preliminary interpretations of these results within their broader regional context.

Keywords: Archaeobotany – Landscape use – Anatolia – Neolithic – Turkey

Introduction

The Neolithic tell site of Çatalhöyük is situated 50 km southeast of Konya in south-central Anatolia. Originally excavated by James Mellaart between 1961 and 1965, the site is well known for its complex settlement layout and elaborate art (Mellaart 1967). It is also an active icon in Turkish society and politics, has attracted a "new age" following and provides a continuing topic in the discussion of the Neolithic of Turkey. Archaeological survey and excavation began again in 1995 (Hodder 1996, 2000). This paper discusses the main themes emerging from the first full analysis of the macro-botanical remains collected during this project.

Archaeobotanical context

Plant materials, including crop stores, structural timber, collected wild fruits and wooden bowls were found in large quantities in the Mellaart excavation, preserved when buildings were burnt in excavation levels II, III, IV and VI (Table 1). Silicified baskets and mats were also found (Helbaek 1963, 1964; Mellaart 1963, 1964, 1966). At the time of their publication these studies provided a rare glimpse of the ubiquity and diversity of ancient plant use. Helbaek (1964) viewed Çatalhöyük as an agricultural producer and later work suggested that cultivation of the rich soils of the Çumra region could have supported the large population thought to have existed at the site (Todd 1976, p 122). In recent years the whole notion of agricultural production in Turkey during the Neolithic has been challenged. Macrobotanical records suggest complex histories of plant domesticate use and uptake across Turkey (Özdoğan 1997a,b). Agricultural production has been rejected as a major element of the subsistence strategy at Aşıklı Höyük (Esin and Harmankaya 1999) and even at Çatalhöyük itself (Özdoğan 1997b; Balter 1998 - for a review of Central Anatolian Neolithic datasets see Asouti and Fairbairn in press).

Settlement structure, dating and location

In total, fifteen Neolithic building levels have been excavated at Çatalhöyük, showing repeated rebuilding of houses in the same locations, in complex cycles of construction, maintenance and destruction (Farid 1998, 1999; Boivin 2000). Individual buildings had plaster and mud floors, walls, ovens, storage bins and a variety of wall decoration, including wall paintings and sculptures (Mellaart 1967). In addition to the sequence of buildings and middens already investigated, five phases of aceramic Neolithic deposits (pre-level XII phases A-E) have been excavated recently, revealing middens, open fires and, at the base of the mound, dumps reworked by river activity (Farid 1999; Cessford 2001). Pre-level XII phase D has been dated to 7480 - 7080 cal B.C., thus placing it firmly within the early Neolithic, with dates in subsequent building levels ranging from 6640 - 6510 cal B.C. in level VII to 6480 - 6220 cal B.C. in level II (Cessford 2001).

Çatalhöyük is situated on an inactive alluvial fan in the Konya Basin, a closed drainage system fed by waterflows from the surrounding uplands (Fig. 1). The mean July temperature at Çumra (10 km west of the site) is 23.5° C and the mean January temperature 1.4° C, with an average annual precipitation of 245.6 mm (Driessen and de Meester

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Table 1. Summary table of plant remains recorded during the Mellaart excavations at Çatalhöyük with comments made by the investigators. Quantity is a subjective relative scale (A = abundant; F = frequent; O = occasional; R = Rare). Sources: Helbaek 1963, 1964; Mellaart 1963, 1964, 1967; Ryder 1965

Seed present in storage bins (Names follow Helbaek)	**Quantity**	**Comments/Interpretation**
Triticum monococcum	F	Stores. Grains small and not well defined. Grains stored with little chaff
Triticum dicoccum	A	Stores. Grains very large and well defined. Stored with chaff
Triticum aestivum	R	Grains and internodes found among the emmer wheat
Hordeum vulgare var. *nudum*	O	Stores? A six-rowed, compact spiked variety
Pisum sativum	A	Stores. The dominant legume crop
Ervilia ervilia (=*Vicia ervilia*)	R	Stores and stray seeds among the grain
Vicia noeana	O	Stores. A common vetch in the area today
Other seeds and fruits (Names follow Helbaek)		**Comments/Interpretation**
Pisum elatius	R	Found mixed with cultivated pea
Hordeum spontaneum	R	Seeds found mixed with grain
Pistacia atlantica fruits	R	No details of finds
Amygdalus orientale fruits	R	'a little heap comprising a dozen shells' in a building.
Quercus acorns	O	Used for oil or cooked and eaten
Celtis australis fruits	A	Used as wine in later periods
Capsella bursa-pastoris and *Erysimum sisymbrioides* seeds	O	Seeds mixed in piles. Used for oil. One pile in grain bin, another beneath Leopard shrine
Taeniatherum and *Eremopyrum* seeds	R	Spikes mixed with *Eremopyrum* suggested as adornment
Scirpus maritimus tubers	R	Two tubers in Level III
Other remains		**Comments/Interpretation**
Quercus and *Juniperus*	A	Found throughout the burnt building levels
Plant string	R	Binding burials and tools to handles
Plant cloth	R	In burnt burials, possibly flax
Baskets and matting	F	Burnt and naturally silicified specimens in many levels

1969), making the area marginal for rainfed agriculture. During the Neolithic the local alluvial system was still active and the site was probably surrounded by a mosaic of marsh, pool, river channel and swamp environments (cf. Roberts et al. 1996, 1999). The exact nature of the floodplain vegetation remains uncertain due to the lack of reliable local pollen data. Vegetation reconstruction based on seed and charcoal data supplemented by modern analogues (cf. Asouti and Hather 2001; Table 2) suggests that the floodplain probably supported a mosaic of open, herbaceous marshes, dominated by *Bolboschoenus maritimus* and *Phragmites australis*. Marshes were punctuated by woodland stands comprising mainly Salicaceae (willows and poplars) and *Ulmus* (elm) in association with other hygrophilous taxa (Asouti and Hather 2001). Dry sand ridges crossed the alluvial plain (Driessen and de Meester 1969; Fig. 1) and probably carried a dry land flora, whilst the wetland fringes and abandoned channels may have supported halophytic communities. The poor marl soils to the north of the alluvial plain were probably covered by a less degraded version of the steppe vegetation seen today, characterised by low shrubs and grasses. Steppe woodland may have occurred in moist areas where the soils allowed better root penetration (compared to the heavy alluvial clays and the marl) which graded into open park woodland on the colluvium and the hill slopes encircling the Konya plain (Asouti and Hather 2001).

Materials and methods

Systematic sampling of all excavated contexts resulted in the collection of over four thousand flotation samples by the end of 1999. Samples were mainly collected from occupation horizons and fills of buildings in levels VII-X (Butler 1995; Mangafa in Kotsakis 1996; Hastorf and Near 1997; Asouti et al. 1999). External areas were also sampled in levels VII, VIII, IX (middens), XI and XII (both middens and animal pens) and pre-level XII phases A-D (middens, lime burning and possible processing areas) (Asouti et al. 1999). Plant remains that had been burnt *in situ* were found only in the sole partially burnt house that was excavated (Building 1, level VII) and in several external hearths from the pre-level XII layers. Most other rich archaeobotanical assemblages derived from mixed rubbish deposits and debris collected on floors around hearths and ovens.

The targeted sample size was 30 litres, however in practice it varied between 20 and 40 litres depending on the size of the excavated deposit. Samples were processed using two flotation tanks, one of the standard 'Siraf type' and another larger, specially designed tank (Hastorf and Near 1997). Both produced good results with charred, mineralised and silicified plant remains being recovered from both floating and non-floating sample fractions.

Here we present the results from the full analysis of wood charcoals from 48 excavated midden contexts, and of other types of macro-botanical material (seeds, fruits, etc.) from 61 excavation units. In addition, the results from a less detailed phase of analysis (termed Phase 2; see Near 1998) are available for 334 excavated contexts, in which the weights and counts of different classes of plant remains (e.g. cereal grain, wood charcoal, cereal chaff, etc.) have been recorded but the remains have not been identified botanically. Phase 2 analysis included a cross-section of all context types, whilst full analysis focused on the context types likely to be most productive (i.e. hearths and middens).

Nomenclature follows the *Flora of Turkey* (Davis 1965-1988) with crop names following van Zeist (1984, 1985). Charcoal identification used the C. A. Western wood thin section and charcoal reference collections held at University College Lon-

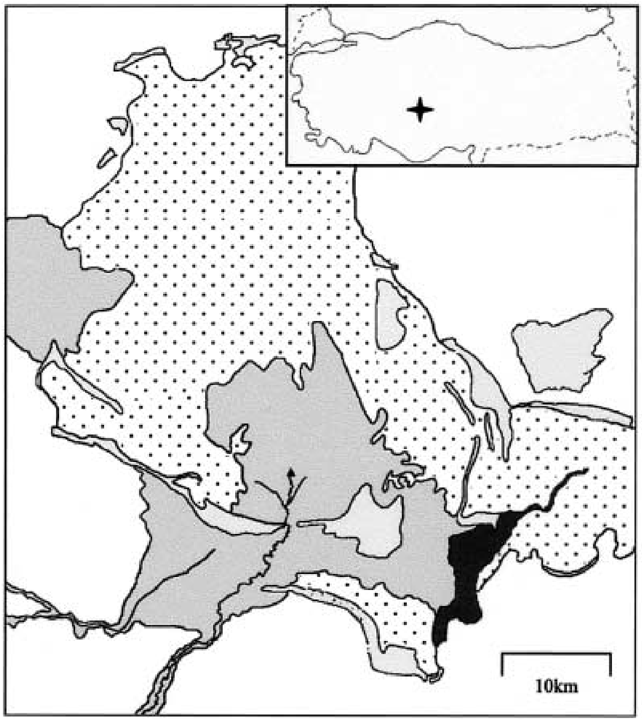


Fig. 1. Map showing the location of the archaeological site and distribution of soils and landforms. ▲ Çatalhöyük ▩ alluvium, ☐ sand, ▩ marl, ■ lake/marsh, ☐ uplands; inset shows position of map in Turkey (✦) (after Roberts et al. 1996)

don, and anatomical descriptions available in Greguss (1959), Fahn et al. (1986) and Schweingruber (1990). Seed and chaff identifications used reference material held in London and Basel, as well as published criteria (see below). Turkey has a very large flora, relatively little of which has been catalogued in seed reference collections, rendering identifications to genus and species difficult. Thus many identifications are to type-level only.

Results

Summary phase 2 ubiquity and frequency data are shown in Table 3, while summary ubiquity and abundance data from full analysis are presented in Table 4. Wood charcoal data are summarised in Table 5.

Crop types

Cereal grain, chaff and pulse crop remains were present throughout the sampled deposits (Tables 3 and 4). Glume wheats dominated the crop assemblages (Table 4), *Triticum dicoccum* (emmer) being the most ubiquitous and abundant of the cultivated species. Relatively few of the *T. dicoccum* grains were suitable for taking measurements because of distortion and damage. Those measured (see Table 6) show that the grains, as reported by Helbaek (1964), were very sizeable (compare with van Zeist and Buitenhuis 1983, van Zeist and Bakker-Heeres 1985, 1986), suggesting that growing conditions were favourable. A change in grain size and shape through time was noted during preliminary analysis, however too few measurements have been made to confirm this observation. Robust specimens of *T. dicoccum* spikelet forks were also identified (Fig. 2) which are comparable to the 'new type' of tetraploid glume wheat described recently from Greece, Austria and Yugoslavia (Jones et al. 2000, Kohler-Schneider 2001, Kroll pers. comm.) They formed part of a continuous range of variation with the other *T. dicoccum* types, and have therefore not been separated in the sample counts.

Triticum monococcum (einkorn) was also a common element of the assemblage, but the abundance of both grains and chaff was always low. Stores consisting only of *T. monococcum* grain recorded by Helbaek suggest that this plant was grown as a separate crop, or at least recognised and stored as such. Grains and spikelet forks of *T. boeoticum* were also identified in small numbers, the latter having a clean disarticulation scar. Grains showed extreme lateral compression and almost parallel dorsal and ventral surfaces when viewed laterally.

Naked wheat grain and rachis segments were also present throughout the sampled levels, although with lower abundance and ubiquity compared to the glume wheats. Most identifiable rachis segments were from hexaploid naked wheat types (*T. aestivum* type), but a few tetraploid rachis segments (from *T. durum* type) were also present. These finds verify the identification of naked wheat at Çatalhöyük by Helbaek, although its presence as a crop grown in its own right has yet to be established (Helbaek reported only grains mixed with emmer stores;

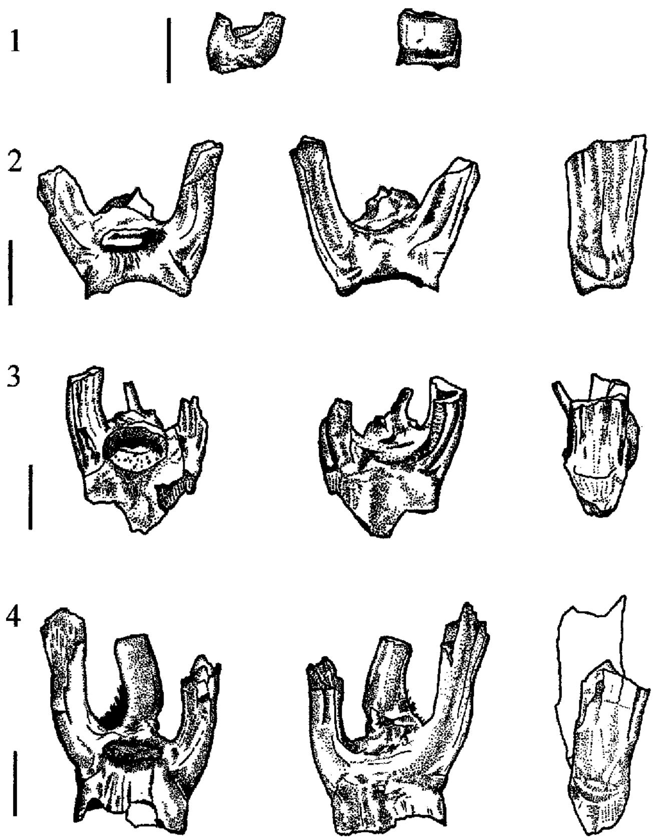


Fig. 2. *Triticum diccoccum* type spikelet forks. 1. Apical spikelet fork. 2. Typical emmer spikelet fork. 3. Similar to 'new type' spikelet fork. 4. Intermediate form of emmer spikelet fork. Scale bar = 1 mm

Table 2. Summary of landforms/habitats, woodland catchments (including formations mentioned in the text i.e. riverine forest, oak park woodland and woodland steppe) and reconstructed woodland composition based on currently available ecological analogues and taxon presence in the charcoal assemblages (Data on ecological analogues available in Zohary 1973, Hillman 2000, Woldring and Cappers 2001 and references therein)

Predicted habitat type	Woodland catchment	Taxa identified in the charcoal assemblages
river banks and alluvial plain	riverine woodland	willow, poplar (Salicaceae) elm (*Ulmus*), ash (*Fraxinus*), tamarisk (*Tamarix*), woody climbers (*Clematis*), vine (*Vitis*), alder (*Alnus*), plane (*Platanus*), chaste tree (*Vitex*)
well-drained alluvial margins	riverine woodland	elm (*Ulmus*), plane (*Platanus*)
saline exposures, ephemeral streams	halophytes	chenopods (Chenopodiaceae), chaste tree (*Vitex*), caper (*Capparis*)
submerged surfaces	marsh vegetation, halophytes (shallow waters)	alder (*Alnus*), reed (*Phragmites*), tamarisk (*Tamarix*), poplar (Salicaceae)
springs	hygrophilous vegetation	fig (*Ficus*), ash (*Fraxinus*)
upland slopes	montane forest, dense oak woodland	black pine (*Pinus* cf. *nigra*), juniper (*Juniperus*), deciduous oak (*Quercus*), maple (*Acer*), legumes (Fabaceae), plums and cherries (*Prunus*), rosebush (*Rosa*)
lower upland zone, foothills	oak park-woodland	deciduous oak (*Quercus*), pears and hawthorns (Maloideae), cherries and plums (*Prunus*), almond (*Amygdalus*), hackberry (*Celtis*), terebinth (*Pistacia*), juniper (*Juniperus*), buckthorn (*Rhamnus*), rosebush (*Rosa*)
fringes of alluvial plains, limestone/chalk outcrops, edges of foothill zone	woodland steppe	almond (*Amygdalus*), terebinth (*Pistacia*), hackberry (*Celtis*), hawthorn (Maloideae), buckthorns (*Rhamnus*), wormwood (*Artemisia*), caper (*Capparis*), labiates (Lamiaceae)
arid plain interiors, marl	treeless steppe	wormwood (*Artemisia*), chenopods (Chenopodiaceae), labiates (Lamiaceae)

see Table 1). Furthermore, our evidence demonstrates that (like the glume wheats) the naked wheats were also present from the earliest excavated phases of the settlement.

Hordeum vulgare var. *nudum* (naked six-row barley) is the only definitely domestic barley in the assemblages reported here and its presence confirms the records by Helbaek. Both chaff and grain were less abundant and ubiquitous than the wheat remains, but were present throughout the sampled levels, two rich deposits being found in the aceramic phases. Both symmetrical and asymmetrical grains have been identified as well as occasional naked-type pedicellate rachis segments (cf. van Zeist and de Roller 1995, p 183). Rachis segments from a two-row form of barley (*Hordeum distichum/spontaneum*) have also been found with both clean and ragged scars, but it is impossible at this time to determine whether the specimens derive from wild or domestic forms.

Table 3. Phase 2 macro-botanical presence data for 334 units (for details of terms and methods see Popper 1988)

Plant remain type	Ubiquity (no of samples where present)	Frequency (% of total samples in which present)
Cereal Grain	330	98.8
Cereal Chaff	325	97.3
Domestic pulse seeds	294	88.0
Hackberry stones	235	70.3
Fruit and nut remains	295	88.3
Dung Remains	88	26.3

Grains and rachis segments tentatively identified as *Secale cereale* (domestic rye) have also been found in small numbers and here the plant probably represents a crop weed. Its presence fits well with recent evidence for the status of rye as an early cereal domesticate in the region (French et al. 1972, Hillman 1978, de Moulins 1997, Nesbitt and Martinoli in press).

Among the legumes *Lens* spp. (lentil) is the most ubiquitous and abundant, its seeds being present throughout the excavated levels in several contexts and found in the only burnt store excavated by the current project. Helbaek did not find lentil, although preliminary work suggests that it was present in the later levels (Mangafa in Kotsakis 1996), thus indicating that Helbaek's sample set, impressive as it was, did not represent all of the exploited crop species. *Vicia ervilia* (bitter vetch) was the next most abundant and ubiquitous taxon, a typical find in Anatolian

Neolithic sites and a likely fodder and food species. *Pisum sativum* (domestic pea), accompanied by occasional specimens of *Pisum elatius* (purple pea), was less common than either of the previous taxa, in contrast to the Helbaek archive in which *Pisum sativum* was the dominant legume. Another probable crop is *Cicer arietinum* (chickpea), the seeds of which were present in 26.1% of the samples, being best represented in the earliest levels (although only one sample contained more than a few seeds of the taxon). Their morphology is compatible with that of *Cicer arietinum* and its wild progenitor *Cicer reticulatum*. The site lies outside the range of the natural distribution of the latter (Zohary and Hopf 2000), thus providing some evidence to support the presence of the domesticate.

Gathered fruits and nuts

The charred remains of fruits and nuts were ubiquitous throughout the sampled sequence (Tables 3 and 4) thus showing that these likely food resources were exploited alongside crop plants for much of the site's life history. *Pistacia* spp. nutlets were among the most ubiquitous types of fruit stones, their form bearing stronger similarities to *P. terebinthus* or *P. atlantica* (the former is the most likely source in this region). Two types of endocarp fragments of species belonging to the Prunoideae sub-family of the Rosaceae were present, including an unidentified *Prunus* species and a ubiquitous type similar to *Amygdalus orientalis*, a taxon originally identified by Helbaek. Hilum and acorn fragments of *Quercus* spp. were common, but were always in low abundance.

Mineralised *Celtis* stones were present in 70.4% of the total sample set (Table 3) and 91.8% of the fully analysed samples (Table 4). They are preferentially preserved in archaeological sites compared to charred remains, surviving without the benefit of charring. Species level identification on the basis of morphology is not possible because the stones of the different native Turkish species in the available reference collection (Institute of Archaeology, University College London) are identical. On ecological grounds *Celtis tournefortii* is the obvious source, as was the case with the Aşıklı Höyük assemblages (van Zeist and de Roller 1995, Ertuğ 2000).

Seeds of *Juniperus* (juniper), *Rhus coriaria* (sumak) and *Capparis* spp. (caper) have also been identified in small quantities and their status as deliberately collected resources is uncertain. *Rhus* seeds looked superficially like a member of the Fabaceae family, being reniform, laterally compressed with rounded ends (~2.5 mm in length) with the laterally placed hilum in the narrowest part of the seed. The seed coat was covered with a fine reticulum. The single possible *Capparis* seed resembles that described by van Zeist and Bakker-Heeres (1985) but, as it was not well preserved, its identification remains uncertain (although caper charcoal was present sporadically in the assemblages; see Table 4).

Wild seed flora

A diverse wild seed flora was preserved (Table 4), mainly charred but also containing naturally siliceous types, especially from the Boraginaceae. Dominant in the assemblage were the seeds of *Bolboschoenus maritimus* (sea clubrush) and small-seeded legumes, especially of the *Astragalus/Trigonella* type. The flora included a well-defined wetland plant list, comprising *B. maritimus*, *Phalaris* sp., *Potamogeton* sp., *Juncus* sp. and *Eleocharis* sp., the latter preserved as charred seeds and white, naturally silicified seeds. Much of the rest of the flora consisted of dry land species that may have derived from steppe, park woodland and arable communities in dry land habitats.

The occurrence of dung fragments in samples throughout the excavated sequence (Tables 3 and 4) suggests that many of the seed remains, as well as grain and chaff, have been derived at least in part from the intentional burning of dung as fuel. Macroscopic dung remains were accompanied by microscopic spherulites, but were preserved in large quantities only in the pre-level XII phases. Pre-level XII phase B contained several deposits in which the remains of heated lake marl (probably deriving from lime plaster production; see Farid 1999, Asouti et al. 1999) were found in association with mineralised sheep dung pellets and macro-botanical assemblages dominated by seeds and chaff (Table 4). Dominant among the seed remains of these were *Bolboschoenus maritimus*, *Astragalus/Trigonella* and several grass species.

Crop cultivation was arguably a major concern of the Neolithic inhabitants of Çatalhöyük and studies of crop weeds have provided the potential to identify whether dry land fields were used for cultivation instead of the alluvial soils. Helbaek (1964) reported evidence of irrigated agriculture, although details of how this conclusion was reached were not provided. Only one *in situ* lentil store has been found during the recent excavations and the accompanying seed assemblage was sparse, containing only a few specimens of *Sisymbrium* type, *Convolvulus* spp., *Polygonum* spp. and *Silene* spp. Many species in these genera are dry land plants, but the limited sample size and the low levels of attainable identification render a dry land crop field location uncertain.

The richest seed assemblages included many potential arable weeds, but most were derived from deposits in which dung fuel was probably burnt. The potential mixing of fodder plants and crop processing by-products makes the arable weed flora difficult to isolate. Several dry land seed types found in the assemblage are common weeds of winter-sown crops in Anatolia (Zohary 1973) such as *Eremopyrum* spp., *Beta* spp., *Bellevalia* spp., *Taeniatherum caput-medusae*, *Sisymbrium* spp., *Convolvulus* spp., *Adonis* spp. and *Vaccaria pyramidata*. Other potential crop weeds include wetland taxa such as the ubiquitous *Bolboschoenus maritimus* and *Eleocharis*, both of which are known as crop weeds in low-lying areas under ard cultivation (Hillman 1991).

Wood charcoals

Table 5 provides a summary of the wood charcoal identifications from the selected midden samples, grouped according to the two major stratigraphic divisions of the site, namely the middens belonging to the later phases of the settlement (levels VII-IX) and the aceramic external refuse deposits (pre-level XII phases A-D). In addition to these datasets, that reflect mainly the exploitation of wood as fuel, further information concerning the use of timber has come from the identification of charred construction

Table 4. Summary macro-botanical data for Çatalhöyük East by Excavation Level, sum (S) ubiquity (Ub) and frequency (% fr)
Part A: Potential economic and common wild taxa

Level	All			VI -VIII		IX-X		XI-XII		PXII-A		PXII-B		PXII-C/D	
No. Units	61			23		13		5		5		7		8	
Vol. (l)	1748			685		238		127		180		210		308	
Taxon	Σ	Ub	%fr	Σ	Ub	Σ	Ub	Σ	Ub	Σ	Ub	Σ	Ub	Σ	Ub
Dung	-	29	47.5	-	16	-	1	-	2	-	2	-	4	-	4
Cereal grains:															
Triticum boeoticum Boiss. emend. Schiem.	56	15	24.6	52	13	2	1	-	-	-	-	-	-	2	1
T. monococcum L. type	392	39	63.9	125	21	5	2	5	2	134	4	16	3	107	7
T. dicoccum Schubl. type	1387	44	72.1	517	20	13	5	2	1	299	5	126	6	430	7
T. monococcum L. / *T. dicoccum* Schubl.	531	26	42.6	265	9	-	-	5	3	54	-	53	7	154	7
Triticum aestivum L. / *T. durum* Desf.	746	33	54.1	74	16	5	2	1	1	151	5	126	2	389	7
Triticum spp.	1504	40	65.6	439	14	11	2	12	5	460	5	105	6	477	8
Hordeum vulgare var. *nudum*	399	33	54.1	89	6	18	7	18	5	193	5	40	4	41	6
Secale cereale L.	14	4	6.6	4	1	9	2	-	-	-	-	-	-	1	1
Cerealia	4613	51	83.6	1868	13	213	13	89	5	842	5	708	7	893	8
Cereal chaff:															
Triticum boeoticum Boiss. emend. Schiem. (G)	51	6	9.8	49	5	2	1	-	-	-	-	-	-	-	-
T. monococcum L. type (G)	894	41	67.2	680	18	35	7	8	3	136	5	13	3	22	5
T. dicoccum Schubl. type (G)	20519	59	96.7	16729	24	280	13	152	5	1648	5	544	6	1166	6
T. monococcum L. / *T. dicoccum* Schubl. (G)	20909	61	100	14108	23	430	13	360	5	2749	5	1291	7	1971	8
T. aestivum L. type (R)	558	26	42.6	248	6	12	3	12	3	152	5	114	5	20	4
T. durum Desf. type (R)	30	5	8.2	8	2	-	-	-	-	16	1	2	1	4	1
Triticum aestivum L. / *T. durum* Desf. (R)	906	26	42.6	716	15	16	1	12	3	124	3	14	2	24	2
Hordeum vulgare var. *nudum* (R)	96	12	19.7	72	7	-	-	9	2	6	1	9	2	-	-
H. distichum L. / *H. spontaneum* C. Koch (G)	40	13	21.3	34	10	1	1	-	-	2	1	-	-	3	1
cf. *Secale cereale* L. (R)	22	5	8.2	12	3	1	1	-	-	-	-	9	1	-	-
Large-seeded legumes:															
Cicer cf. *arietinum* L.	133	16	26.2	8	5	1	1	-	-	25	3	56	2	43	5
Lathyrus sativus L. / *L. cicera* L.	88	15	24.6	10	5	-	-	-	-	3	2	18	2	57	6
Lens sp.	1953	45	73.8	602	20	6	2	3	3	292	5	139	7	911	8
Pisum elatius Bieb. type	2	1	1.6	-	-	-	-	-	-	-	-	-	-	2	1
P. sativum L. type	85	12	19.7	15	4	-	-	2	1	7	2	-	-	61	5
Pisum spp.	69	17	27.9	24	8	2	1	-	-	13	2	2	1	28	5
Vicia ervilia (L.) Willd.	571	38	62.3	64	13	13	4	6	4	101	5	37	5	350	7
Vicieae	1562	31	50.8	368	9	59	8	34	1	157	5	513	2	431	6
Fruits/nuts:															
Amygdalus L. type (Number)	59	41	67.2	14	14	2	2	5	5	22	5	8	7	8	8
Celtis sp. (Number)	1498	56	91.8	107	19	82	13	17	4	502	5	76	7	714	8
Ficus sp.	142	12	19.7	34	5	-	-	-	-	11	3	-	-	97	4
Juniperus sp. (Number)	5	2	3.3	-	-	-	-	-	-	1	1	-	-	4	1
Pistacia sp. (Number)	374	37	60.7	21	14	-	-	6	5	28	5	86	5	233	8
Prunus sp. (Number)	14	11	18.0	6	3	3	3	1	1	2	2	1	1	1	1
Quercus sp. (Number of hilar scars)	20	10	16.4	1	1	-	-	1	1	12	5	2	2	4	1
Quercus sp. (Weight of shell/endosperm)	1.330g	18	29.5	0.464g	6	0.783g	7	0.019g	3	0.000g	-	0.064g	2	0.000g	-
Rhus coriaria L.	3	2	3.3	-	-	-	-	-	-	-	-	-	-	3	2
Rubus sp.	1	1	1.6	-	-	-	-	-	-	-	-	1	1	-	-
Other wild taxa (seeds unless specified):															
Aeluropus Trin.	703	23	37.7	89	8	120	1	61	1	8	1	192	6	233	6
Alcea type	234	7	11.5	-	-	-	-	-	-	2	1	1	1	231	5
cf. *Alopecurus* sp.	13327	43	70.5	10625	17	63	5	22	3	832	5	513	7	1272	6
Alyssum spp.	1007	10	16.4	48	4	-	-	4	1	28	2	12	0	915	3
Astragalus/ *Trigonella* types	6600	46	75.4	401	13	57	8	228	5	558	5	3559	7	1797	8
Atriplex spp.	738	19	31.1	-	-	1	1	2	2	37	5	570	6	128	5
Bolboscheoenus maritimus (L.) Palla.	11606	59	96.7	1179	21	627	13	492	5	1540	5	3941	7	-	8
Carex spp.	467	29	47.5	282	13	24	3	8	3	125	5	20	3	8	2
Chenopodium/ *Atriplex* spp.	2071	42	68.9	958	17	16	2	19	5	364	5	156	5	558	8
Cruciferae spp.	1926	18	29.5	354	10	-	-	1	1	28	2	13	2	1530	3
Cyperaceae	685	13	21.3	424	6	98	1	-	-	20	3	9	2	134	1
Eleocharis spp.	421	22	36.1	22	3	43	4	18	5	192	4	5	2	141	4
Eleocharis spp. (Silicified seeds)	459	18	29.5	8	1	-	-	30	5	220	4	46	5	155	3
Eremopyrum type	424	35	57.4	52	9	4	4	4	3	181	5	49	6	134	8
Erucaria type	726	10	16.4	37	2	-	-	1	1	19	4	13	2	656	1
Helianthemum spp.	2981	23	37.7	31	5	14	3	2	2	73	3	88	4	2773	6
Labiatae spp.	446	14	23.0	406	10	-	-	1	1	-	-	4	1	35	2
Phalaris spp.	262	22	36.1	120	9	-	-	6	2	76	3	48	5	12	3
Gramineae spp.	681	36	59.0	334	15	38	6	10	-	114	4	66	5	119	6
Polygonaceae spp. (Endosperm)	884	21	34.4	815	14	-	-	-	-	8	1	11	4	50	2
Polygonum spp.	579	41	67.2	392	18	11	3	6	3	11	4	78	7	81	6
Rumex spp.	396	14	23.0	8	3	1	1	-	-	230	3	2	2	155	5
Sisymbrium type	3015	23	37.7	1320	11	-	-	1	1	249	4	24	3	1421	4
Stachys spp.	1208	26	42.6	698	12	1	1	6	2	180	3	21	2	302	6
Taeniatherum caput-medusae Nevski	566	29	47.5	233	5	2	2	12	5	209	5	92	7	18	5
T. caput-medusae Nevski (G)	538	19	31.1	220	5	10	3	16	4	182	5	110	2	-	-
Trifolium type	268	12	19.7	133	4	7	2	-	-	3	1	3	2	122	3
Vaccaria pyramidata Medik.	747	24	39.3	685	9	4	1	2	2	15	3	30	5	11	4

Table 4. Summary macro-botanical data for Çatalhöyük East by Excavation Level, sum (S) ubiquity (Ub) and frequency (% fr)
Part B: Less common wild taxa

Level	All			VI -VIII		IX-X		XI-XII		PXII-A		PXII-B		PXII-C/D	
No. Units	61			23		13		5		5		7		8	
Taxon	Σ	Ub	%fr	Σ	Ub	Σ	Ub	Σ	Ub	Σ	Ub	Σ	Ub	Σ	Ub
Adonis spp.	30	12	19.7	8	2	1	1	1	1	4	3	4	3	12	2
cf. *Aegilops* spp.	54	7	11.5	-	-	-	-	-	-	33	3	-	-	21	4
cf. *Aegilops* spp. (G)	106	7	11.5	-	-	-	-	-	-	67	3	-	-	39	4
Alismataceae	63	5	8.2	-	-	-	-	-	1	-	-	1	1	62	3
Anagallis sp.	111	5	8.2	109	4	-	-	-	-	-	-	-	-	2	1
Androsace sp.	43	5	8.2	-	-	-	-	-	-	4	1	-	-	39	4
Arenaria spp.	1	1	1.6	1	1	-	-	-	-	-	-	-	-	-	-
Arnebia decumbens (Vent.) Cosson & Kralik	179	15	24.6	-	1	-	-	3	2	28	5	8	5	140	2
Artemisia annua L. type	26	4	6.6	-	-	-	-	-	-	1	1	1	1	24	2
Artemisia vulgaris L. type	6	4	6.6	-	-	-	-	1	1	-	-	3	2	2	1
Atriplex tatarica L.	1	1	1.6	-	-	-	-	-	-	-	-	-	-	1	1
Bellevalia sp.	2	2	3.3	-	-	-	-	-	-	1	1	1	1	-	-
Beta spp.	91	10	16.4	9	1	-	-	-	-	5	4	1	1	76	4
Boraginaceae	2	1	1.6	-	-	2	1	-	-	-	-	-	-	-	-
Bromus spp.	173	22	36.1	131	9	2	2	5	2	6	2	14	5	15	2
Buglossoides arvensis Moench type	97	13	21.3	11	3	-	-	16	1	45	4	5	3	20	2
Buglossoides tenuiflorum (L. fil.) Johnston type	53	8	13.1	41	2	7	3	-	-	-	-	-	-	5	3
Campanulaceae	2	1	1.6	2	1	-	-	-	-	-	-	-	-	-	-
Camphorosma type	40	4	6.6	36	2	-	-	-	-	-	-	-	-	4	2
cf. *Capparis*	1	1	1.6	-	-	-	-	-	-	-	-	1	1	-	-
Capsella sp.	190	5	8.2	3	-	2	2	-	-	160	1	-	-	25	2
Caryophyllaceae spp.	264	16	26.2	181	8	2	2	-	-	17	2	20	3	44	1
Centaurea/Cirsium Miller type	179	17	27.9	11	2	20	3	-	-	112	4	7	2	29	6
Cephalaria	96	4	6.6	-	-	-	-	-	-	-	-	4	1	92	3
Cicer sp.	4	3	4.9	2	1	-	-	-	-	1	1	-	-	1	1
Compositae	52	9	14.8	31	4	-	-	1	1	3	2	-	-	17	2
Convolvulus sp.	127	20	32.8	86	11	2	1	-	-	29	3	4	1	6	4
Crucianella sp.	14	6	9.8	13	5	-	-	-	-	-	-	-	-	1	1
Echium sp.	20	3	4.9	18	1	-	-	2	2	-	-	-	-	-	-
Erodium L'Herit type	31	8	13.1	17	5	-	-	-	-	-	-	-	-	14	3
Euphorbiaceae	5	3	4.9	4	2	-	-	-	-	-	-	-	-	1	1
Galium/Asperula large types	48	18	29.5	18	9	-	-	-	-	19	5	3	2	8	2
Galium/Asperula small types	128	14	23.0	26	4	3	2	-	-	26	4	52	2	21	2
Geranium sp.	3	3	4.9	-	-	-	-	-	-	-	-	-	-	3	3
Glaucium sp.	10	2	3.3	-	-	-	-	-	-	-	-	-	-	10	2
Gramineae spp. (Culm)	75	11	18.0	2	1	-	-	-	-	53	4	16	5	4	1
Gypsophila sp.	18	5	8.2	4	1	-	-	1	1	-	-	13	3	-	-
Heliotropium sp.	93	11	18.0	8	1	5	1	1	1	1	1	7	3	71	4
Hibiscus trionum L.	64	9	14.8	-	-	-	-	-	-	36	3	23	4	5	2
Holosteum sp.	34	2	3.3	33	1	-	-	-	-	-	-	-	-	1	1
Hordeum spp.	55	14	23.0	6	3	-	-	2	2	13	4	33	4	1	1
Hyoscyamus cf. *reticulatus* L.	3	1	1.6	-	-	-	-	-	-	-	-	-	-	3	1
cf. *Isatis* sp.	105	3	4.9	100	1	-	-	-	-	-	-	4	1	1	1
Juncus spp.	110	12	19.7	8	2	-	-	3	1	72	4	17	2	10	3
Koeleria type	2	2	3.3	-	-	-	-	1	1	-	-	-	-	1	1
Leguminosae	91	13	21.3	-	-	-	-	1	1	15	3	19	4	56	5
Lepidium type	162	5	8.2	15	1	-	-	-	-	64	2	-	-	83	2
Linum spp.	8	3	4.9	1	1	-	-	-	-	-	-	-	-	7	2
cf. *Lupinus* sp.	4	1	1.6	-	-	-	-	-	-	-	-	-	-	4	1
cf. *Lycopus* sp.	7	4	6.6	4	2	-	-	-	-	-	-	-	-	3	2
Malva spp.	72	17	27.9	44	7	3	2	-	-	12	3	4	2	8	3
Malvaceae	24	8	13.1	4	2	-	-	2	1	4	1	5	2	9	2
Onopordon sp.	10	1	1.6	-	-	-	-	-	-	-	-	-	-	10	1
Phlomis sp.	103	10	16.4	102	9	1	1	-	-	-	-	-	-	-	-
Potamogeton sp.	2	1	1.6	-	-	-	-	-	-	-	-	-	-	2	1
Salsola type	60	12	19.7	12	3	-	-	10	4	24	2	-	-	14	3
Silene spp.	12	5	8.2	12	5	-	-	-	-	-	-	-	-	-	-
Stipa sp.	40	9	14.8	16	3	-	-	-	-	8	1	2	2	14	3
Stipa type (awn)	77	5	8.2	15	4	-	-	-	-	-	-	-	-	62	1
Suaeda sp.	26	7	11.5	13	2	-	-	2	2	-	-	2	1	9	2
Teucrium type	27	4	6.6	-	-	-	-	1	1	2	1	-	-	24	2
Texiera galstifolia Jaub. & Spach.	33	4	6.6	25	1	-	-	-	-	2	1	-	-	6	2
Thymelaea sp.	242	9	14.8	110	4	5	1	-	-	4	1	120	1	3	2
Umbelliferae spp.	59	11	18.0	30	6	-	-	-	-	4	1	14	1	11	3
Valerianella sp.	8	2	3.3	4	1	-	-	-	-	-	-	4	1	-	-
Verbena sp.	84	6	9.8	-	-	-	-	-	-	1	1	-	-	83	5
Ziziphora spp.	16	7	11.5	2	1	-	-	-	-	8	1	4	3	2	2
Indeterminate charred seeds	3629	57	93.4	1116	22	232	10	63	5	1169	5	576	7	473	8
Total mineralised seeds	484	16	26.2	29	3	1	1	417	3	23	5	5	2	9	2

Notes on Table 4 (A and B): Nomenclature follows Davis (1965-1988) for wild taxa and the traditional system described in Zohary and Hopf (2000). Sample volume (Vol. (l)) is a composite of all analysed samples per level given in litres. Grain, *Celtis, Amygdalus*, *Pistacia* and *Prunus* sums include fragments converted to whole specimen equivalents by weight (0.001 g, 0.073 g, 0.9 g, 0.021 g and 0.9 g respectively). Glume equivalents (G) are shown (i.e. 1 spikelet = 2 glumes, except in the case of einkorn); rachis abundance (R) is based on number of the rachis segments and has been doubled for naked wheat and trebled for naked barley to allow better comparison with grain numbers. Additional explanations see legend of Table 5.

timber preserved *in situ* (for details on the charcoal identifications see Mellaart 1967, Newton 1996). According to these accounts, *Quercus* spp. (deciduous oak) was the most commonly used structural timber at the site, with *Juniperus* spp. (juniper) and *Ulmus* spp. (elm) being less common.

The taxa retrieved from the charcoal assemblages probably derived from a broad range of habitats across the Konya plain and can be split into three main groups, all of which were ubiquitous in the samples (Table 5, Fig. 4; for details see Asouti and Hather 2001):

1. Taxa that were exploited primarily as timber, including *Quercus* (deciduous oak) and *Juniperus* (juniper), likely to have originated in park woodland formations on the Neogene terraces (cf. Driessen and de Meester 1969) and the foothills of the surrounding upland zone. The closest stands to Çatalhöyük would have been located ~10-12 km to the south of the site.
2. Riverine species originating in the local alluvial plain, used primarily as firewood, including mainly Salicaceae (willows and poplars) and *Ulmus* spp. (elm).
3. Dry land fruit trees and shrubs exploited for forage and firewood (*Celtis*, *Amygdalus*, *Pistacia*, Maloideae - most likely *Crataegus* spp.) from the park woodland on the hills to the south, and woodland steppe formations abutting park woodland and/or occupying ecotonal zones between the alluvial plain and the steppe.

A less common and abundant group of woody shrubs, including *Artemisia* spp., Chenopodiaceae and Lamiaceae, has also been identified in the charcoal assemblages. Using modern ecological analogues (see Table 2) they are believed to have originated in the treeless arid steppe distributed mainly to the north of the site.

A major temporal change in sample composition (most evident in the percentage fragment counts of the charcoal taxa) has been identified in the charcoal assemblages from the midden deposits (Figs. 5, 6). Samples pre-dating pre-level XII phase A (including the earliest midden unit [4846] of pre-XII phase A; see column 3 in Table 5) are dominated by the riverine (Salicaceae, *Ulmus* spp.) and fruit-producing taxa (*Celtis* spp., *Amygdalus* spp., *Pistacia* spp.) with minor presence/abundance values of *Quercus* spp. and *Juniperus* spp. (Fig. 6, Table 5). Pre-level XII assemblages also display much lower frequencies for *Fraxinus* spp., *Prunus* spp., *Tamarix* spp., Fabaceae, Chenopodiaceae, Asteraceae and Lamiaceae, all of which are very much under-represented compared to samples from the late middens.

Since the pre-level XII charcoal assemblages are from a relatively restricted excavated area, the study of further comparative samples is necessary in order to confirm beyond doubt this temporal change in sample composition. However, given the nature of the examined contexts (external refuse deposits) and the universality of this pattern in the early samples, we believe that it may reflect a genuine temporal change in firewood procurement practices.

Deciduous oak in particular, shows a rise in its abundance in the late levels. One could also postulate a likely contextual derivation for this change in sample composition, but it must be stressed that the pattern has been established for deposits belonging to the same context type (i.e. external refuse deposits, most likely to reflect lasting patterns of fuel use).

Discussion

Our research largely confirms the range of crops reported for the later levels by Helbaek (1964) and Mangafa in Kotsakis (1996) and is consistent with crop records from contemporary sites in central Anatolia, such as Aşıklı Höyük (van Zeist and de Roller 1995), Erbaba (van Zeist and Buitenhuis 1983) and Can Hasan III (French et al. 1972). The major addition is the record of *Lens* (lentil), absent from Helbaek's report, hence demonstrating how burnt *in situ* stores may be unrepresentative of general crop presence.

The crop assemblage suggests that there was little innovation in crop use over the millennium of site use. This qualitative comparison is supported by quantitative analysis of crop remains from midden deposits (Fig. 3, Table 7). Correspondence analysis split the samples into two groups along the first axis, with those clustered to the left containing relatively high proportions of chaff and those to the right higher grain/legume seed abundance. Samples separated along the second principal axis contained naked barley rachises. All groups included samples from different building levels, thus suggesting that the observed patterning largely reflects differences in the distribution of burnt crop processing debris rather than a diachronic change in crop presence.

Preliminary analysis of the seed flora has provided no evidence for the use of the damper alluvial soils for arable fields, although confirmation of this pattern requires further study. Only dry land weeds have significant numerical correlations with crop products and by-products (Table 8). Correlation coefficients of seed abundance to grain in 24 samples which contained at least 200 identifiable elements, indicate a significant correlation for several potential large-seeded weed species (Table 7). Correlation coefficients for small-seeded types and chaff do not show the same pattern. The coefficients provide some supporting evidence that the crops were, at least in part, grown on the drier soils, although further work on a larger sample set is required to confirm this pattern.

There are indications that many of the seed remains, as well as grain and chaff, have derived at least in part from the intentional burning of dung as fuel as dung fragments were found in samples throughout the excavated sequence (Tables 3 and 4). We believe that many of the wetland plant seeds, especially *Bolboschoenus maritimus*, were derived from animal graze and fodder or were mixed with arable weeds and chaff used as fodder. Another possibility is that they were added to dung to improve its quality as fuel.

The predominantly dry land flora has implications for reconstructing the location of the crop fields in the Neolithic environment of Çatalhöyük. In the closed hydrological system of the Konya plain (lacking a drainage outlet) groundwater levels would have been permanently high. Prolonged waterlogging and the spring floods, which could have inundated large areas of the alluvial basin for several weeks, would have destroyed any autumn-sown crops that had not been planted in raised locations. In the absence of levées (as indicated by the available geomorphological evidence; Neil Roberts pers. comm.), the only possible raised areas close to the site would have been un-

Table 5. Summary wood charcoal counts (sum and % of total sum) and presence data (Ub = ubiquity (number of samples in which taxon was present) and %fr. = frequency (percentage ubiquity)) for main stratified groups of midden deposits at Catalhöyük (PXIIA-D is an abbreviated form of pre-level XII phases A-D). Taxa are arranged in broad ecological groups as summarised in Table 2. Column 3 contains samples from pre-level XII phases A-D split into two main groups on the basis of differences observed in sample composition. Percentage fragment counts have been calculated after the exclusion of indeterminate fragments from sums

	Fragment counts				Presence				Fragment counts			
EXCAVATION LEVELS	VII-IX		PXIIA-D		VII-IX		PXIIA-D		PXIIA		PXIIA[4846]-D	
Taxa	Sum	%	Sum	%	Ub	%fr.	Ub	%fr.	Sum	%	Sum	%
Salicaceae	341	10.66	436	25.16	27	100.0	21	100.0	140	18.89	296	29.84
Ulmus spp.	91	2.84	76	4.39	25	92.6	13	61.9	3	0.40	73	7.36
Fraxinus spp.	25	0.78	1	0.06	13	48.1	1	4.8	1	0.13	-	-
Tamarix spp.	8	0.25	2	0.12	7	25.9	2	9.5	-	-	2	0.20
Alnus spp.	13	0.41	-	-	5	18.5	-	-	-	-	-	-
Vitex spp.	6	0.19	2	0.12	3	11.1	2	9.5	-	-	2	0.20
Platanus spp.	2	0.06	2	0.12	2	7.4	1	4.8	-	-	2	0.20
Capparis spp.	2	0.06	1	0.06	2	7.4	1	4.8	1	0.13	-	-
Ficus spp.	2	0.06	-	-	2	7.4	-	-	-	-	-	-
Juniperus spp.	136	4.25	10	0.58	25	92.6	8	38.1	3	0.40	7	0.71
Pinus spp.	1	0.03	-	-	1	3.7	-	-	-	-	-	-
Acer spp.	10	0.31	-	-	5	18.5	-	-	-	-	-	-
Fabaceae	93	2.91	4	0.23	17	63.0	2	9.5	4	0.54	-	-
Quercus spp.	1821	56.92	428	24.70	27	100.0	15	71.4	411	55.47	17	1.71
Clematis spp.	1	0.03	3	0.17	1	3.7	1	4.8	-	-	3	0.30
Celtis spp.	174	5.44	170	9.81	24	88.9	17	81.0	80	10.80	90	9.07
Pistacia spp.	62	1.94	31	1.79	21	77.8	14	66.7	8	1.08	23	2.32
Maloideae	120	3.75	22	1.27	21	77.8	9	42.9	9	1.21	13	1.31
Amygdalus spp.	31	0.97	20	1.15	13	48.1	9	42.9	-	-	20	2.02
Prunus spp.	29	0.91	2	0.12	16	59.3	2	9.5	-	-	2	0.20
Rosa spp.	9	0.28	1	0.06	6	22.2	1	4.8	-	-	1	0.10
Asteraceae	34	1.06	20	1.15	18	66.7	8	38.1	10	1.35	10	1.01
Lamiaceae	22	0.69	3	0.17	14	51.9	2	9.5	-	-	3	0.3
Chenopodiaceae	20	0.63	7	0.40	12	44.4	6	28.6	1	0.13	6	0.6
Ulmaceae	134	4.19	473	27.29	25	92.6	21	100.0	65	8.77	408	41.13
Cornus spp.	1	0.03	1	0.06	1	3.7	1	4.8	-	-	1	0.10
Caprifoliaceae	1	0.03	-	-	1	3.7	-	-	-	-	-	-
Indet.	**851**	**-**	**1207**	-	-	-	-	-	**309**	**-**	**898**	-
Total	**4050**	**100**	**2940**	**100**	**27**	**100**	**21**	**100**	**1050**	**100**	**1890**	**100**
Total (-Indet.)	**3199**	**-**	**1733**	-	-	-	-	-	**741**	**-**	**992**	-
Quercus spp.	1821	56.92	428	24.70	27	100.0	15	71.4	411	55.47	17	1.71
Juniperus spp.	136	4.25	10	0.58	25	92.6	8	38.1	3	0.40	7	0.71
Pinus spp.	1	0.03	-	-	1	3.7	-	-	-	-	-	-

dulations in the underlying Pleistocene marl (Roberts et al. 1996, 1999). However, much of the marl is extremely calcareous and prone to winter waterlogging and thus does not provide viable crop growing locations.

This combination of factors implies that traditional autumn-sown cropping is unlikely to have occurred in the immediate environs of the site. Spring sowing of cereal crops is not evidenced at the site and is in any case unlikely, given that during this early period vernalisation was still required to allow cereal seed production. By contrast, the spring and early summer cropping of legumes (especially *Vicia ervilia*) is possible, and its rapid seed maturation (Palmer 1998, p 137) may have been an important property in this region where rainfall is erratic. Perhaps *Vicia ervilia* was used to provide a catch-crop on recently exposed alluvium. A similar cropping pattern has been reported for traditional contemporary Ethiopian agriculture (Ann Butler, pers. comm.)

Beyond the local marl hummocks, the closest viable dry land areas suitable for agriculture are the foothill zone and the Neogene terraces flanking the north-facing exposures of the Taurus range, ~10-12 km to the south of the site. The same zone also appears to have been a major source of timber and firewood (notably of park woodland and woodland steppe taxa). It is interesting to note here that the most locally abundant woods (i.e. the riverine forest) were not used for timber as happened for example in Cafer Höyük (eastern Anatolia). Here riverine woods, particularly Salicaceae, were evidently selected in preference to oak not only as fuel but also for construction purposes

Table 6. Measurements of emmer grains from pre-level XII phase C and level VIII. L = length; B = Breadth; T = thickness; L/B = length/breadth ratio; T/B = thickness/breadth ratio

		L	B	T	L/B	T/B
Level VIII	min.	5.3	2.5	2.2	2.12	0.88
N = 8	mean	6.06	3.1	2.73	1.96	0.88
	max.	7.3	3.6	3.4	2.03	0.94
Level Pre-XII C	min.	5.4	2.2	2	2.45	0.91
N = 24	mean	6.46	2.8	2.54	2.3	0.9
	max.	7.7	3.3	3.1	2.33	0.94

(Willcox 1991). Similar patterns are evident in several sites in the northern Euphrates (Mureybet, Abu Hureyra, Jerf el Ahmar, Dja'ade, Halula), suggesting that riverine forests, rather than oak and terebinth-almond woodlands, were preferentially exploited for firewood (cf. Helmer et al. 1998, Willcox 1992, Roitel and Willcox 2000).

Trees from the park woodland zone also provided edible fruits, which were ubiquitous in the samples as is the case with other Neolithic sites in the region. *Celtis*, *Pistacia* and Prunoideae species were most visible and probably provided a useful seasonal food resource. There is little evidence for large-scale storage or processing of wild fruits at Çatalhöyük (either in the current excavation

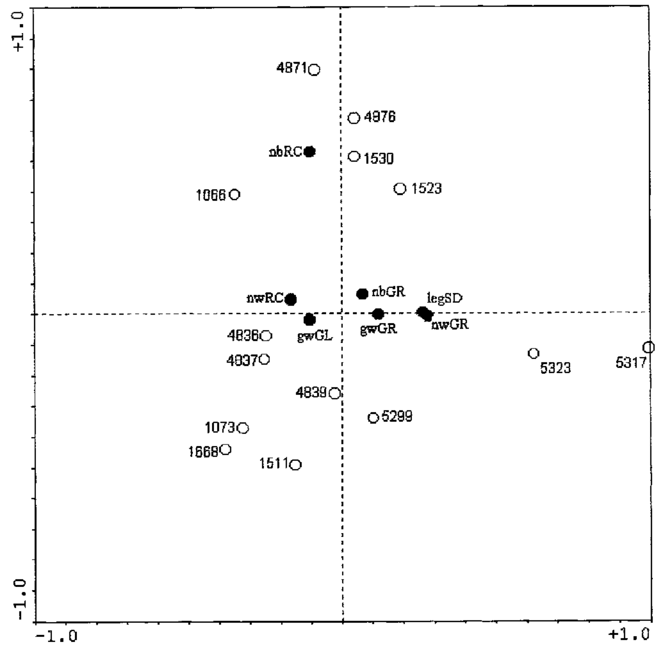


Fig. 3. Correspondence analysis of crop abundance data in Table 7. Abbreviations for species points as in Table 7. Cumulative variance for axes 1 and 2: 71.2% and 83.4% respectively

Table 7. Crop abundance data from midden/dump samples with large crop seed and chaff assemblages (note: PXIIA – C is the equivalent of pre-level XII phases A – C). GR = grain; GL = glumes; RC = rachis

Unit.Sample	**1073**	**1511**	**1066**	**1523**	**1530**	**1668**	**4836**	**4837**	**4839**	**4871**	**4876**	**5299**	**5317**	**5323**
Level	***VII***	***VII***	***VII***	***VIII***	***VIII***	***VIII***	***PXIIA***	***PXIIA***	***PXIIA***	***PXIIB***	***PXIIB***	***PXIIC***	***PXIIC***	***PXIIC***
Space	***105***	***105***	***115***	***115***	***115***	***115***	***181***	***181***	***181***	***181***	***181***	***181***	***181***	***181***
Sample Volume(litres)	***32***	***102***	***34***	***38***	***32***	***42***	***28***	***35***	***34***	***39***	***33***	***38***	***22***	***37***
Triticum monococcum GR	8	2	12	9	7	8	7	-	40	1	-	19	51	14
T. dicoccum GR	6	27	154	27	21	46	22	35	66	17	31	63	239	41
T. monococcum/dicoccum GR	3	1	16	-	5	-	22	7	-	3	9	22	71	33
Sum of Glume Wheat GR (gwGR)	**17**	**30**	**182**	**36**	**33**	**54**	**51**	**42**	**106**	**21**	**40**	**104**	**361**	**88**
Triticum aestivum sl. GR	2	3	20	8	5	10	5	9	9	9	9	29	237	62
Sum of Naked Wheat GR (nwGR)	**2**	**3**	**20**	**8**	**5**	**10**	**5**	**9**	**9**	**9**	**9**	**29**	**237**	**62**
Hordeum vulgare var. *nudum* GR	2	4	6	2	3	-	11	5	5	4	9	4	10	5
Sum of Naked Barley GR (nbGR)	**2**	**4**	**6**	**2**	**3**	**-**	**11**	**5**	**5**	**4**	**9**	**4**	**10**	**5**
Triticum monococcum GL	130	-	174	2	2	136	65	60	2	-	9	12	6	-
T. dicoccum GL	460	770	3816	426	226	3604	439	423	660	150	161	833	36	235
T. monococcum/dicoccum GL	480	264	1558	206	286	996	892	942	552	570	306	1588	163	89
Sum of Glume Wheat GL (gwGL)	**1070**	**1034**	**5548**	**634**	**514**	**4736**	**1396**	**1425**	**1214**	**720**	**476**	**2433**	**205**	**324**
Triticum durum type RC	-	-	-	-	-	-	-	16	-	-	2	-	-	-
T. aestivum type RC	-	-	-	-	-	-	4	88	22	48	16	-	-	6
T. durum/aestivum type RC	16	-	112	8	2	92	120	-	2	4	-	18	-	-
Sum of Naked Wheat RC (nwRC)	**16**	**-**	**112**	**8**	**2**	**92**	**124**	**104**	**24**	**52**	**18**	**18**	**-**	**6**
Hordeum vulgare var. *nudum* RC	-	-	18	3	3	-	-	-	-	6	3	-	-	-
Sum of Naked Barley RC (nbRC)	**-**	**-**	**18**	**3**	**3**	**-**	**-**	**-**	**-**	**6**	**3**	**-**	**-**	**-**
Cicer cf. *arietenum*	-	-	-	1	-	-	2	1	-	3	-	1	30	5
Lathyrus sativus/cicera	-	-	-	2	-	-	2	-	-	-	1	25	21	-
Lens spp.	5	11	3	130	10	18	3	11	6	42	22	202	380	182
Pisum sativum type	-	-	-	-	-	-	1	-	-	-	-	-	40	3
Vicia ervillia	2	2	4	9	25	6	19	9	46	8	14	31	144	51
Sum of domestic legumes (legSD)	**7**	**13**	**7**	**142**	**35**	**24**	**27**	**21**	**52**	**53**	**37**	**259**	**615**	**241**

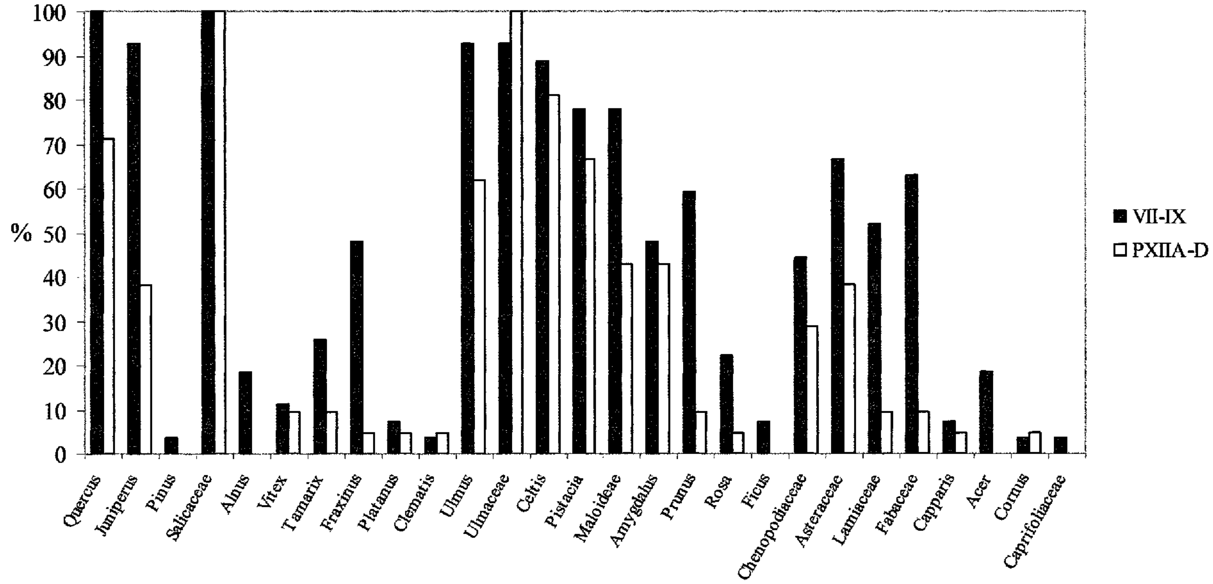


Fig. 4. Bar chart showing percentage ubiquity scores of charcoal for all external refuse deposits from Çatalhöyük (48 samples)

or the work of Helbaek), unlike plant domesticates which were present in abundance from the earliest phases of the settlement. Therefore, as well as being an integral part of the resource procurement system, crops were probably the main source of storable foods at the site. This conclusion does not correspond with those in some recently published articles, which envision a limited role and contribution of agricultural production in the Anatolian Neolithic, both for earlier sites and for Çatalhöyük itself (see above).

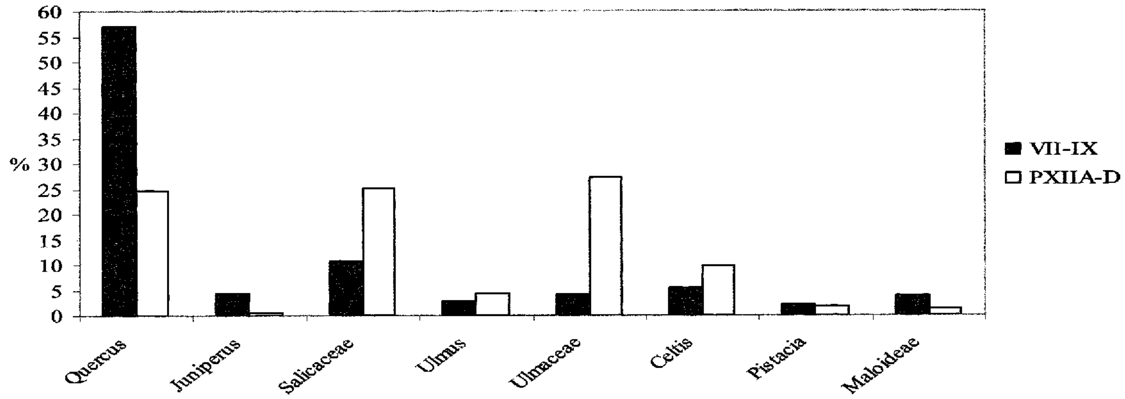
Beyond human food, wild resources, especially sedges and grasses, were used in basketry (Rosen in Asouti et al. 1999). This suggests that some of the grass seeds, especially *Eremopyrum* type, may have entered the site with materials for craft resources. Evidence from the burnt dung layers in pre-level XII phase B suggests that a major use for the wild vegetation of the area might have been as a source or fodder and grazing for domestic animals. Both local (wetland) and more distantly sourced (dry land) species are repeatedly represented in the dung-rich deposits, again suggesting the exploitation of a broadly utilised catchment area. Chaff remains in dung, and in some cases cereal grain and pulse seeds, also indicate the use of agricultural by-products as fodder, thus pointing towards a certain degree of integration of arable and pastoral production. Overall, it appears that indications of human plant use at the site are merged with those of animal diet and dung-fuel preparation (cf. Bottema 1984, Miller and Smart 1984, Miller 1996).

It also appears that the collection of firewood primarily from the local wetland environments during the early phases of the settlement was replaced in later periods by a strategy characterised by the extraction of wood resources from a much broader catchment area, with intensive exploitation of the foothill zone. Such a shift might have been further necessitated by the over-exploitation of the locally available riverine forest vegetation.

This may also indicate the transformation of Quercus from being mainly a timber species to a major firewood source as well. An alternative explanation might be its absence from the regional vegetation during the early phases of the settlement (roughly pre-8000 uncal B.P.). However, both the presence of oak charcoal in the early midden samples and the recently published off-site palaeoecological sequences from Central Anatolia (Roberts et al. 2001) have positively indicated that oak woodland was already present in the region by the time of the founding of Çatalhöyük. Because the pattern has been established for deposits of the same context type (external refuse deposits most likely reflecting a long time of fuel use) sample composition should not be the reason for this change.

Furthermore, the examination of 77 samples from various contexts belonging to the late excavation levels has indicated high abundance values for deciduous oak in almost every context type, ranging from *in situ* hearth debris to mixed external deposits (Asouti, in prep.) thus offering additional credit to the widespread use of deciduous oak wood as fuel during later periods. *Quercus* wood fuel could have originated from a broad range of activities including the re-use of defunct structural timber, the burning of timber preparation by-products (knots, twigs and larger branches) and, finally, its purposeful collection as firewood (Asouti, in prep.).

Crop production, the collection of wild fruits, timber and firewood procurement, pastoral provision and the extraction of craft resources all appear to have been based on the exploitation of many of the contemporary vegetation associations and sub-environments spread over a wide area of the southern Konya plain. The hill slope zone appears to have been a major resource base for the inhabitants of Çatalhöyük and its continuous use, without any evidence of landscape degradation, throughout the period of the Neolithic occupation suggests that the plant resource procurement zone may have been carefully controlled and managed. Furthermore, the apparent coincidence of field and tree resources in one landscape unit to the south of the settlement suggests that the area formed one of Çatalhöyük's 'territories', perhaps the most important one in terms of the range and intensity of activities taking place there. The hills may have thus formed a true cultural landscape to complement that of the immediate floodplain en-



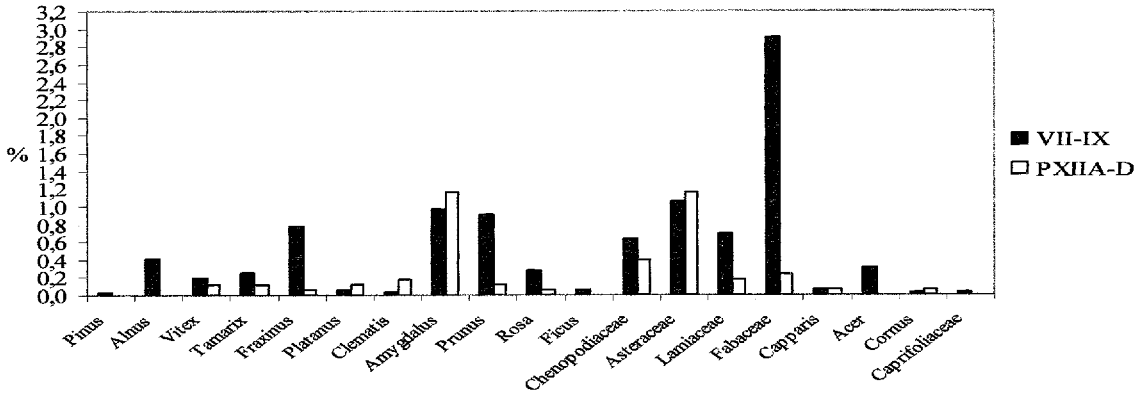
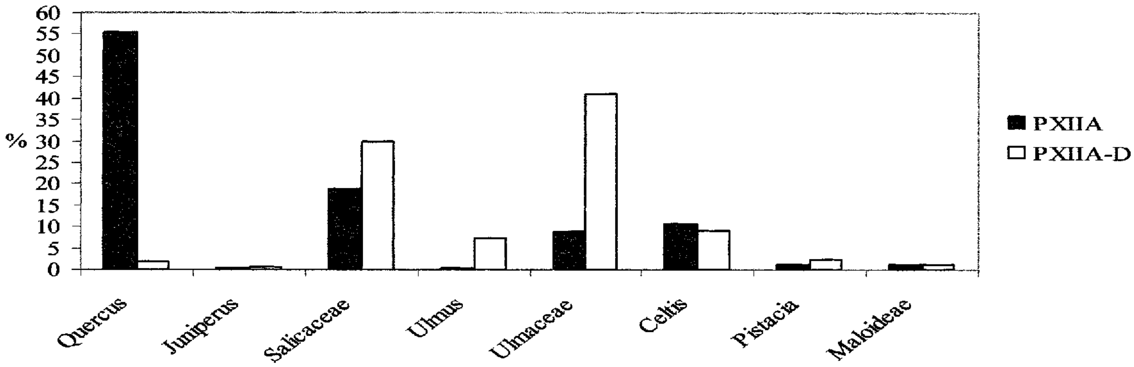


Fig. 5. Percentage charcoal fragment counts for all external refuse deposits at Çatalhöyük samples (sums exclude indeterminate fragments). The upper chart shows the major taxa and lower chart minor taxa in the assemblages



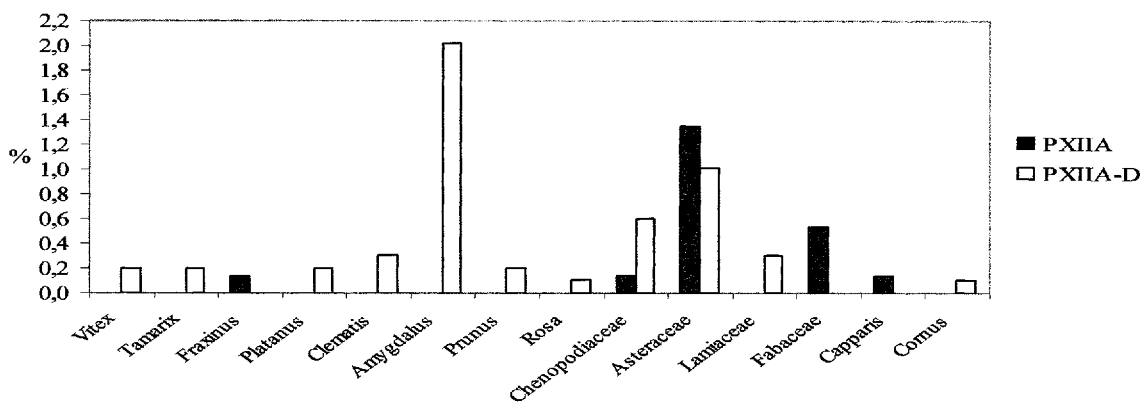


Fig. 6. Percentage charcoal fragment counts for midden/dump units of excavation levels pre-XII phase A (- 4844) and pre-XII phase A (4846) - phase D (sums exclude indeterminate fragments). The upper chart contains the major taxa and the lower chart the minor taxa in the assemblages.

Table 8. Pearson correlation data for the abundance of potential weed seeds to chaff and grain abundance in 24 midden samples at Çatalhöyük. Bold figures indicate statistically significant correlations (Seed property classification follows Jones 1987: BFH = big, free, heavy seeds; BHH = big, headed, heavy seeds; SFH = small, free, heavy seeds); SP = Seed Properties; Cg = Correlation to grain; S = Significance; Cc = Correlation to chaff

Taxon	SP	Cg	S	Cc	S
Adonis spp.	BFH	**.518**	**.009**	.090	.682
Bellevalia spp.	BFH	-.247	.256	-.078	.723
Beta spp.	BFH	**.549**	**.007**	-.125	.569
Convolvulus spp.	BFH	**.515**	**.010**	.026	.905
Eremopyrum type	BFH	**.514**	**.010**	-.047	.832
Galium large-seeded	BFH	**.456**	**.025**	.096	.662
Vaccaria pyramidata	BHH	-.158	.460	-.011	.959
Bolboschoenus maritimus	SFH	.396	.056	-.159	.469
Buglossoides arvensis	SFH	.245	.260	.018	.936
Chenopodium/Atriplex spp.	SFH	**.435**	**.033**	-.095	.666
Eleocharis spp.	SFH	.221	.311	-.093	.673
Rumex spp.	SFH	**.540**	**.008**	-.140	.524
Sisymbrium type	SFH	**.525**	**.010**	-.174	.426
Stipa spp.	SFH	**.680**	**.000**	-.080	.715
Suaeda spp.	SFH	.401	.052	**.601**	**.002**
Taeniatherum caput-medusae	SFH	-.037	.865	.266	.220

SP = Seed Properties; Cg = Correlation to grain; S = Significance; Cc = Correlation to chaff

vironment of the site. The botanical records from both fruit stones and wood charcoals provide additional 'hard' evidence for the regular exploitation of the 'wild orchard' species of Central Anatolia (cf. Woldring and Cappers 2001) before and during the period of the early-mid Holocene woodland expansion. Rather than rapid deforestation and the diminution of park woodland the evidence from Çatalhöyük also suggests that the exploitation of trees for timber, firewood and fruits was sustainable for several centuries.

The emerging interpretation of the archaeobotanical remains from Çatalhöyük further challenges the notion that early agricultural sites were initially occupied because of their suitability for optimal arable production. The archaeobotanical evidence considered in context indicates that the Neolithic community of Çatalhöyük routinely exploited and managed widely dispersed territories. Such a dispersed pattern of resource use could have been well suited to the extreme environmental gradients characterising the Konya Basin and its inherent climate and resource instability. Perhaps Çatalhöyük serves to demonstrate how the construction of permanent dwellings and the exploitation of plant domesticates should not be assumed to go hand in hand with reduced seasonal mobility. Furthermore, it suggests that uniform assumptions about the distance of exploited territories (inherent for example in classic site catchment analysis) may be inappropriate explanatory tools when discussing some prehistoric communities.

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