Introduction

Baaz Rockshelter is located approximately 35 km northeast of Damascus (Figs. 1, 2a, b) immediately adjacent to the Jaba′deen Pass at an elevation of 1,529 m a.s.l. Due to its many springs, this pass serves as both a reliable source of water and a means for moving between the lowlands and the highlands of the westernmost Palmyride Mountains (Conard 2006). The region has an annual rainfall of about 200 mm. The present day vegetation in the Damascus region consists of a steppe dominated by thorny bushes: *Artemisia herba-alba* (white wormwood), *Achillea santolina* (santolin yarrow), *Centaurea* (cornflower), *Stipa* (feather grass), *Festuca* (fescue), *Poa* (bluegrass) and *Carex* (sedge). In higher locations, Cyperaceae, Poaceae (*Secale montanum*, *Bromus tomentellus*, *Agropyrum libanoticum*), *Astragalus* and *Acantholimon* (prickly thrift) are present (Kaiser et al. 1973, p 275). Hardly any trees are currently growing away from water sources and recent plantations. Moreover, no cedar (*Cedrus*) is found on the eastern slopes of the Lebanon range and on the Anti-Lebanon Mountains today. The Cilician fir (*Abies cilicica)* has its southern limit in the Ehden forest in Lebanon. This tree is presently not found in the Anti-Lebanon. Bottema (1975–1977) has shown that in the Upper Barada, about 35 km southwest of Baaz, deciduous oak (*Quercus*) park woodland occurred during Medieval times. Bottema also indicated that relatively recently, ca. 200 years ago, vegetation clearance took place as interpreted by the reduction in arboreal pollen and an increase in weed and crop plant pollen.

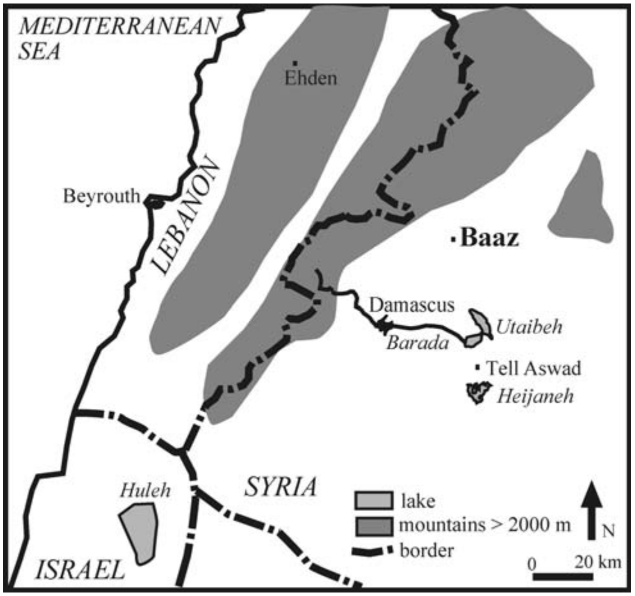
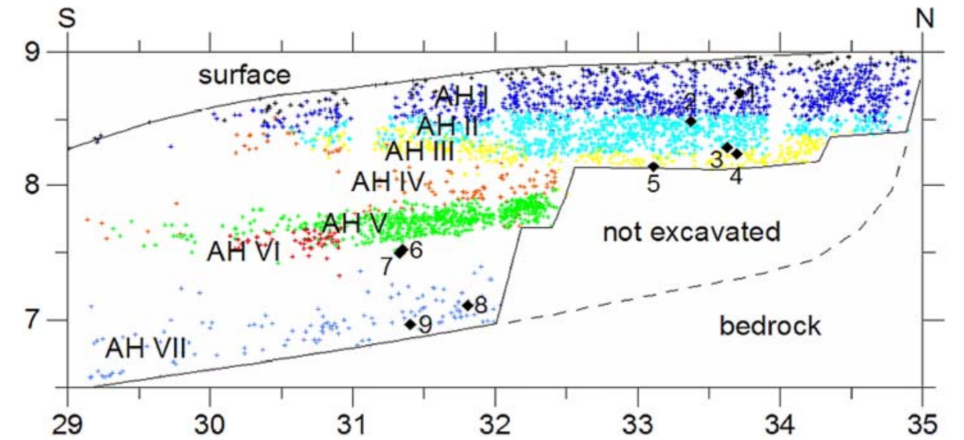


Fig. 1 Location of Baaz–sites with relevant palaeoenvironmental information indicated on map

The small rockshelter site of Baaz was excavated between 1999 and 2004 by a joint Damascus-Tübingen team (Conard 2006). Seven major archaeological horizons have been identified (Fig. 3), each representing occupation periods between ca. 34 kyr B.P. and the late fifth millennium cal. B.C. The lowermost strata (IV, V, VI and VII), which have been reached in the southernmost area of the excavation only, reflect Upper Palaeolithic occupation in the Late Pleistocene. Two radiocarbon dates were retrieved from stratum VII and reflected dates between ca. 34 and 32 kyr B.P., while two from stratum V provided a date between ca. 23 and 21 kyr B.P. Contrary to the upper strata of the rockshelter, the lower horizons, with the exception of stratum V (Fig. 4), contained less cultural material and the deposits were mainly formed by geological processes. No archaeological structures have yet been documented within the lowermost strata and macro-botanical remains are scarce. Radiocarbon dates on the charcoal, and artefacts from the archaeological horizons III and II, indicate a more significant phase of occupation in the Late Natufian during the eleventh and perhaps late twelfth millennium cal. B.C. (Conard 2002, 2006). It is important to note that this phase

Fig. 2 Baaz rockshelter: **a** Location (see *arrow*) with Wadi Jaba′deen in front, **b** view towards the southeast, **c** Natufian floor level IIIb with built-in mortar and fireplace



lab number	m^2 - find #	AH	material	uncalibrated	calibrated 1 sigma cal BC
1) KIA11580	20/33 - 163	I	charcoal	5241±35 BP	4216-4203, 4136-4134, 4045-3983
2) KIA11579	20/33 - 425	II	charcoal	5707±34 BP	4578-4572, 4552-4495, 4469-4464
3) KIA11578	20/33 - 672	II	charcoal	10667±97BP	10962-10821, 10813-10680, 10500-10492
4) KIA11577	20/33 - 714	III	charcoal	10942±65 BP	11161-11113, 11074-10935
5) KIA11576	20/33 - 745	IIIa	charcoal	10470±121 BP	10865-10348, 10284-10178
6) KIA30307	19/31 -1067	V.1	charcoal	21310+740/-680 BP	n.a.
7) KIA30308	19/31 - 1068	V.1	charcoal	23040+ 270/-260 BP	n.a.
8) KIA30309	19/31 - 1403	VII	charcoal	34200+1460/-1240 BP	n.a.
9) KIA30310	19/31 - 1413	VII	charcoal	32060+600/-560 BP	n.a.

Fig. 3 Profile projection of piece-plotted finds from the excavation units of the 20 East row showing the location and dating results for nine charcoal samples. The five radiocarbon dates younger than 12,000 B.P. were calibrated using CALIB rev4.0, test version 6 (Stuiver et al. 1998)

Fig. 4 Rich lithic artefact finds in level V from Baaz

had an associated in situ floor (Fig. 2c) with a hearth and a built-in mortar at the level of horizon IIIb. The lithic artefacts from the Natufian strata suggest that a variety of activities took place, probably ranging from hunting, preparing meat and plant resources, wood working to the manufacturing of lithic artefacts (Barth 2006). One of the radiocarbon dates of horizon II suggests some intrusions of later occupation remains into this level, although most of the artefacts of horizon II belong to the Late Natufian (Conard 2002). A radiocarbon sample of the uppermost horizon I provided a late fifth millennium cal. B.C. date. However, the lithic artefacts also indicate remains of occupation in horizon I from the earlier Pre Pottery Neolithic A (PPNA) (Barth 2006). Although some pockets of charcoal were found within this horizon, no in situ structures were found which could be due to the fact that this horizon is disturbed. Horizon I did not contain any artefacts related to the preparation of food plants, such as mortars, pestles, etc. Most of the lithic finds were probably associated with hunting, preparing meat and knapping (Barth 2006). The scarcity of tools for preparing plant-foods suggests that the site was not occupied permanently in the Early Holocene or that plant processing was not a major activity (Barth 2006).

The occupation phases observed in Baaz took place under differing climatic conditions. There are varying reconstructions of the Pleistocene climate in the Eastern Mediterranean, (e.g. reviews and discussion in Tzedakis 2007 and Enzel et al. 2008 with different conclusions). While some consider the Pleistocene in the Near East as extremely dry compared to the Holocene, others suggest much moister conditions prevailed than at present throughout much of the Pleistocene. Most climatic reconstructions agree that Baaz III and II are within the range of the Levantine Younger Dyras (Robinson et al. 2006), which is characterised by a dry spell after a phase of more moist climatic conditions.

The present study focuses on charcoal, fruit and seed, and phytolith remains from the archaeological horizons III to I in order to document vegetation changes and subsistence evolution between the Natufian and Chalcolithic periods. Additionally, the analysis of palynological and some macrobotanical samples from the Late Pleistocene strata will allow the extension of the vegetation reconstruction back to the Late Pleistocene. Moreover, the pollen samples from the upper horizons of the site enable a comparison between vegetation reconstructions based on anthracological, macrobotanical and phytolith remains, and pollen.

Up until now, little information existed on the vegetation evolution within this time span in the Damascus region. Palynological studies were conducted at Lake Utaibeh and Heijaneh, around 30 and 40 km respectively south of Baaz, in an area that at present receives less than 150 mm rain per year. Early studies indicated poor pollen preservation within the sediments of both lakes (Bottema 1975–1977). Recently better pollen samples have been retrieved, but no detailed chronology could be established (Hussein 2006). Anthracological research at the Early Neolithic Tell Aswad provides information on the vegetation in the area around the lakes for the period between 8600 and 7500 B.C. *Populus* (poplar)/*Salix* (willow) and *Tamarix* (tamarisk) dominated the area due to its location close to lakes. However, *Fraxinus* (ash), *Phragmites* (reed) and *Vitis* (vine) were also present (Pessin 2004). Only a small proportion of steppic taxa were found, such as *Pistacia atlantica* (great terebinth) and Chenopodiaceae. In addition, a few fragments of *Cedrus* (cedar) were found (Pessin 2004). Two palynological samples from the same tell and period provided mainly Asteraceae. Additionally, there was also pollen of *Artemisia*, *Thalictrum* (meadow-rue), *Amygdalus* (almond), *Quercus* and *Ephedra* (Kaiser et al. 1973).

The pollen core from Huleh, which is located ca. 120 km southwest of Baaz, is one of the most important palaeovegetation records for the wider region covering this period (Baruch and Bottema 1991). There are, however, large uncertainties in the radiocarbon chronology of this core (Meadows 2005). The original published age models for Huleh suggest that during the Last Glacial Maximum, oak woodland continued to survive in the area. At about 16000 cal B.C. a steady expansion of woodland occurred. From ca. 11500 until 10500 cal B.C., the diagram shows a sharp reduction in woodland from 80% of arboreal pollen at its maximum to only ca. 30% at its minimum. After 10500 cal B.C., some woodland expansion took place again. However, during the following sequence, woodland taxa did not attain such high proportions as before (Tsukada in van Zeist and Bottema 1982; Baruch and Bottema 1991). The age models have recently been slightly revised by applying a correction based upon the δ^{13}C of the sample (e.g. Cappers et al. 2002). However, Meadows (2005) presented a review of Cappers et al. (2002) from which he concluded that the revised radiocarbon chronology for Huleh still contradicts marine records and other terrestrial and archaeological records of palaeoclimate and palaeoenvironment. The marine records indicate that during the Last Glacial Maximum and Younger Dryas, conditions were relatively dry and cold and herbaceous pollen was abundant, with Chenopodiaceae especially increasing considerably (Rossignol-Strick 1995).

Only little is known about the vegetation in the Damascus province during the Pleistocene. Although up until now the occupation remains that have been found in Baaz belonging to the Upper Palaeolithic are rather scarce, recent surveys suggest the region was intensively occupied during the Upper Palaeolithic (Dodonov et al. 2007).

The Natufian is often regarded as representing a particularly important episode for the intensification of wild plant exploitation because of an increase in sedentism (Valla 1998). Many, though not all, investigators have turned to climate, especially the dry spell of the Younger Dryas, as a possible explanation for this intensification (e.g. Bar-Yosef 1996, 2001, 2002; Bar-Yosef and Belfer-Cohen 1989, 1991, 2002; Henry 1989; Sherratt 1997. See also Willcox 2005 and Bottema 2002 who argue for a more moderate importance of the Younger Dryas in the emergence of agriculture). The Huleh core yields regional information for the lake surroundings; however the composition of the local vegetation and the impact that the Younger Dryas may have had on the Damascus region remain unknown.

The aim of this study is to reconstruct the vegetation in the Baaz surroundings during the Late Pleistocene, the Younger Dryas (layers II and III), and the following periods, and to gain an understanding of the type of occupation and activities that took place at Baaz.

Methodology

Macrobotanical samples were retrieved from all strata. Several sampling procedures were undertaken. Conventional flotation samples were taken mainly from horizons I, II and III, but also a few from stratum IV and V. The samples from horizons I, II and III contained much charcoal, but few fruits and seeds which were often badly preserved. The flotation samples of levels IV and V were generally much less rich in botanical remains and contained few charcoal fragments that were larger than 2 mm. In order to maximise the data, the charcoal fraction smaller than 2 mm has been investigated, while for the later periods only charcoal fractions larger than 2 mm were analysed.

Identification of seeds, fruits and charcoal was made using the modern reference collection hosted at the University of Tübingen. Besides flotation samples from the three upper horizons, some charcoal fragments were mapped and collected as single finds (mainly larger pieces) from all horizons. In total, 11,545 charcoal fragments from 33 flotation samples (Figs. 5, 6; Table 1) and 84

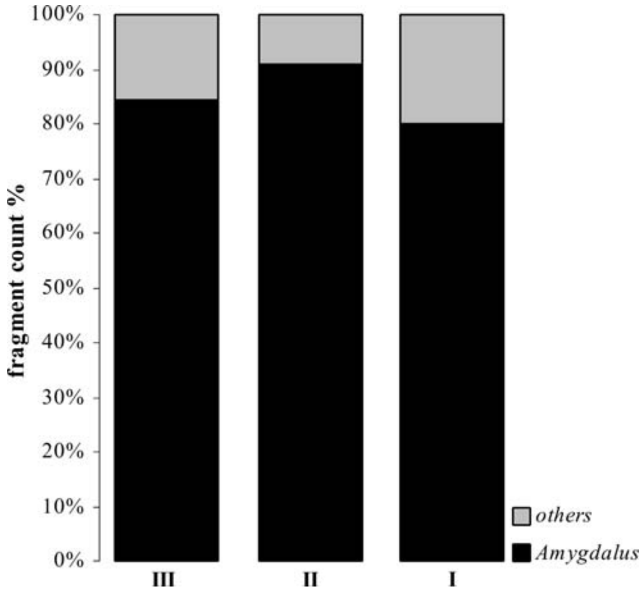


Fig. 5 Summary fragment percentage chart of the charcoals from horizons I, II and III from Baaz

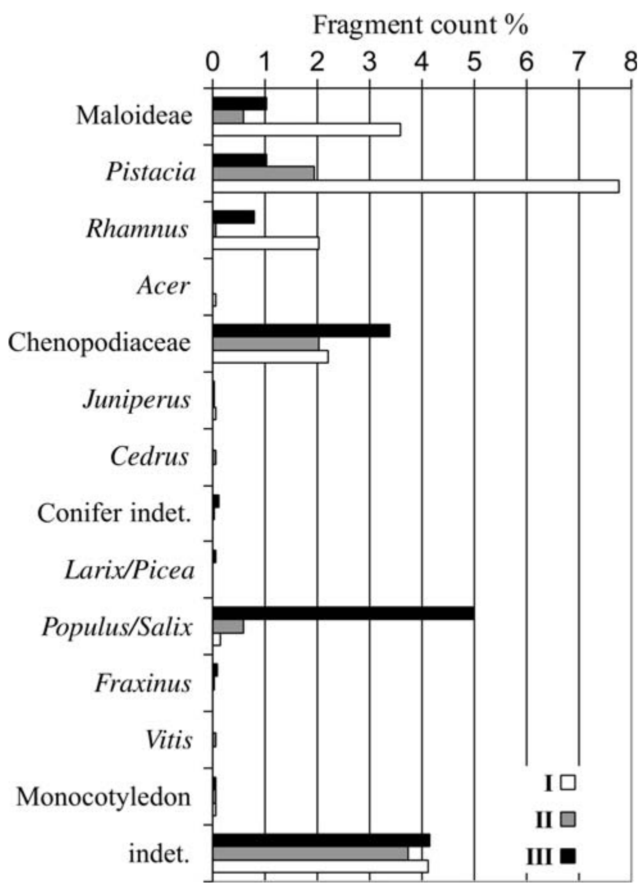


Fig. 6 Fragment percentage chart of all taxa present at Baaz minus *Amygdalus*

Table 1 Floated charcoal samples identified from Pleistocene strata from Baaz

	VII		V		IV		III		II		I	
	F	*P*	*F*	*P*	*F*	*P*	*F*	*P*	*F*	*P*	*F*	*P*
Amygdalus	–	–	1	1	31	1	55	7	–	–	222	7
Maloideae	–	–	–	–	–	–	–	–	–	–	–	–
Rhamnus	–	–	–	–	–	–	–	–	–	–	2	1
Acer	–	–	–	–	–	–	–	–	–	–	1	1
Populus/Salix	–	–	11	3	25	4	684	39	141	5	270	8
Chenopodiaceae	7	7	–	–	4	1	–	–	–	–	–	–
Juniperus	–	–	–	–	–	–	27	4	–	–	–	–

F number of fragments, *P* present in number of samples

Table 2 Non-floated fragments identified from Baaz

	V		IV	
	F	*P*	*F*	*P*
Amygdalus	2	1	71	4
Artemisia	7	1	2	2
Tamarix	–	–	1	1
Populus/Salix	1	1	3	2
Chenopodiaceae	5	1	–	–
indet.	–	–	4	1

F number of fragments, *P* present in number of samples

hand-picked samples (Table 2) were identified. Identifications were based on fresh transverse, tangential, and radial fractures at magnifications of 60×, 100×, 200× and 500× and were achieved with the use of several wood anatomy atlases (e.g. Gale and Cutler 2000; Fahn et al. 1986). It is often assumed that charcoal samples from archaeological sites are representative of the availability of woody plants in the habitation environment. Based on this assumption, the percentage of a charcoal taxon in the samples is used to indicate the relative abundance in the local vegetation (see discussion in Asouti and Austin 2005, p 2). However, human preferential selection may also have some influence on the charcoal fragment proportion of the site. Compared to palynology, anthracology has the advantage that it can document the presence of insect-pollinated species (e.g. Rosaceae species and maple) that will be underrepresented in pollen diagrams.

While the charcoal samples tend to document mainly the larger woody plants, palynology can provide additional insight into the shrubs and herbs. A total of 16 pollen samples were analysed from the archaeological strata at Baaz. The number of pollen grains varied by horizon. The most complete pollen assemblages were obtained in the cultural horizons VI and VII and in the layer 30 cm from the top of the Baaz section, as well as in a separately collected sample from cultural horizon IV. Overall, the interpretation of pollen from archaeological strata is rather complicated. In the case of Baaz, no mudbrick was used as building material, so most sediments arrived on site through a combination of rockshelter collapse and eolean input. The uppermost archaeological horizons (III-I) are more anthropogenic in nature than the underlying horizons and therefore a greater influence of human plant use on the pollen spectrum in the upper horizons is to be expected. Additionally, because the pollen samples from horizons III to I derive from the uppermost 20 to 10 cm, there may also be some recent disturbance in the pollen spectrum.

Within this study, 20 phytolith samples were analysed. Phytoliths were extracted from sediment using the protocol of Rosen (1999) at the Institute of Archaeology, University College London. The slides were counted on a Zeiss microscope at 400× magnification. The results were calculated using the absolute count method developed by Albert et al. (2003). The aim of this method is to show the absolute counts of phytoliths per gram based on the original weight of the total sediment sub-sampled. For each slide, 300–400 single-cell and 100 multi-cell phytoliths were recorded. For some slides, it was not possible to count 100 multi-celled varieties due to their scarcity. In these instances, every other row was counted until the end of the slide was reached. Identifications were made using the phytolith reference collection of A. Rosen (UCL London).

Results

Charcoal

The hand-picked samples (Table 1) were not included within the fragment percentage charts. They contained mostly *Populus/Salix*, and were retrieved close to one another especially in square 19/32 of horizon IIIa, but also some hand-picked samples from Pleistocene contexts were investigated. From stratum VII (from which no flotation samples have yet been excavated), all hand-picked samples identified consisted of Chenopodiaceae species, while in levels V and IV *Amygdalus*, *Populus/Salix* and Chenopodiaceae were found.

The results of the flotation samples from the Pleistocene strata V and IV are depicted separately from those from later strata because a different fraction was analysed and therefore the results are not completely comparable (Table 2). *Artemisia, Amygdalus* and *Populus/Salix* were present in strata V and IV, while Chenopodiaceae were only present in stratum V and *Tamarix* in stratum IV.

The results of the charcoal identifications from strata III to I are represented here as fragment count percentages per horizon (Figs. 5, 6). Ubiquities will not be presented due to the rather small number of samples. However, it must be mentioned that all samples are very similar to one another in proportions and in presence of taxa. *Amygdalus* was dominant, comprising 84% of the fragments identified in horizon III, almost 91% of those in horizon II and 80% in horizon I (Fig. 5). Also, *Pistacia, Rhamnus* (buckthorn), Maloideae spp., Chenopodiaceae, *Juniperus* (juniper), *Populus/Salix* and monocotyledons occur in the three horizons, though in rather small percentages (Fig. 5). The Maloideae constitute a particularly anatomically homogenous group and may have consisted of species of *Cotoneaster*, *Crataegus* and *Pyrus*.

Vitis (vine) and *Cedrus* are only present in horizon II, while *Larix* (larch)/*Picea* (spruce) is only present in horizon III, and *Fraxinus* is in III and II. *Acer* (maple) is only present in the flotation samples of horizon I. The most striking trend is a decrease in the fragment proportions of *Populus/Salix* from horizon III to I, while there are relatively more Maloideae, *Pistacia* and *Rhamnus* in horizon I.

Many *Amygdalus* and *Pistacia* fragments were small twigs, however a small twig from *Populus/Salix* was also found. Moreover, it is noteworthy that a lot of the hand-picked *Populus/Salix* fragments from stratum I to III were affected by wood boring insects.

Table 3 summarizes the habitats of the woody plant taxa identified. Most of the taxa from Baaz, such as *Amygdalus*, *Pistacia*, *Rhamnus*, Maloideae spp. and Chenopodiaceae, grow in a shrubby steppe. Another group of taxa, like, for example, *Populus/Salix*, *Fraxinus* and *Vitis* probably belonged to the riversides. Occasionally, some taxa from mountainous areas are present within the samples.

Fruits and seeds

The flotation samples contain very few fruits and seeds. The few fruits and seeds that were found were often badly preserved, with the exception of Fabaceae. Table 4 lists the investigated samples. Mostly small-seeded Fabaceae (including *Astragalus* spp.) and remains of wild Poaceae were found. *Astragalus* was most frequent, not only due to

Table 3 Identified woody taxa and their habitats with an indication of their abundance according to size of the dots

	Amygdalus	Maloideae	*Pistacia*	*Rhamnus*	*Acer*	Chenopodiaceae	*Juniperus*	*Cedrus*	*Larix/Picea*	*Populus/Salix*	*Fraxinus*	*Vitis*
woodland steppe	⬤	●	●	●	•	●	•					
mountainous vegetation							•	•	•			
riverine vegetation										●	•	•

Table 4 List of seeds and fruits from Baaz; the lowermost strata IV and V were without fruits and seeds

	Baaz 2004 19/134 97 I	Baaz 2004 19/134 143 II	Baaz 2004 19/134 Z 853 II	Baaz 2004 21/34 320 IIIa	Baaz 2004 19/134 249 IIIa	Baaz 2004 20/34 559 IIIa	Baaz 2004 19/31 932 V	Baaz 2004 19/31 379 IV	Baaz 2004 19/31 387 IV	Baaz 2004 19/31 390 IV
cf. *Alkanna*, fragment, uncarbonized		1								
Astragalus sp.	1	5	1	1	2					
Chenopodium, uncarbonized					1					
Fabaceae, small		4			3					
Hordeum cf. *murinum*					1					
Kickxia cf. *spuria*						1				
Plantago sp.					1			No fruits and seeds		
Poaceae, awn fragment						1				
Poaceae, culm node, fragment				1						
cf. Poaceae, fragment					1					
Rosaceae, Prunoideae, fragment			1							
Vitis vinifera, uncarbonized	1									
indet., fragments	1	1				1				

a better preservability than other small-seeded remains, but also because this thorny shrub may have been a well represented component of the vegetation. Because of its long and often hard prickles, this plant is not favoured by goats. *Astragalus* indicates that the landscape must have been relatively open. More indications of a relatively open vegetation are the findings of *Plantago* and *Kickxia* (Zohary 1973).

There are some uncarbonised finds, most of which are probably modern contaminants, indicating a certain degree of disturbance at the site. This disturbance may also account for the poor preservation of the fruits and seeds.

In several samples from Pleistocene strata no fruits and seeds were found (Table 4).

Phytoliths

The weight percentage of phytoliths in the twenty different samples that were analysed varied greatly. Samples 97 and 28 from horizon I and samples 401 and 124 from horizon II have a far higher percentage of phytoliths per gram than the other contexts analysed from Baaz Rockshelter (Fig. 7a). This increase in phytoliths is related to an increase in both monocotyledons and dicotyledons and is suggestive of a landscape with much greater vegetation cover (Fig. 7b). The presence of long cells from all parts of grasses (smooth long cells are formed in the leaves and stems, whereas dendritic long cells are formed in the husks) demonstrates that whole plants were brought into the site rather than just the inflorescences. Figure 7c–d show that while rondels increase in number in horizon I, bilobes occur more in horizon II and III. Rondels are characteristic phytolith shapes associated with C_3 Festucoid (Pooid) grasses, while bilobe-shaped cells indicate C_4 Panicoid grasses (Twiss 1992).

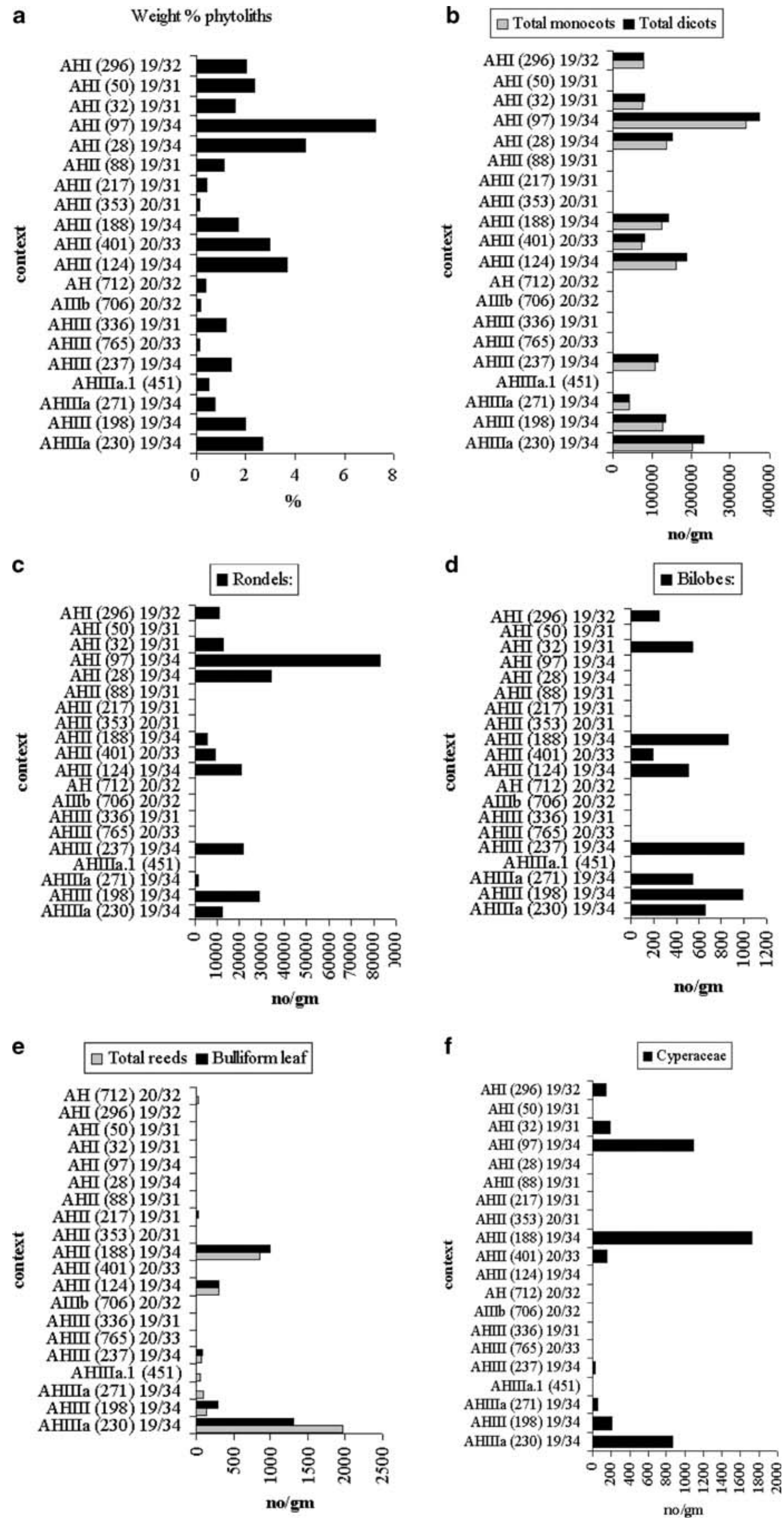
Figure 7e shows the number, per gram, of reed phytoliths and of bulliform leaves (a multi-celled phytolith often formed in reeds). This figure shows that reed phytoliths are more abundant in the contexts from horizons II and III than in horizon I. Sedges can be found sporadically throughout the occupation of the Baaz Rockshelter and are abundant in contexts from horizons I, II and III as shown in Fig. 7f. The presence of sedges indicates that there were moist areas around the site. Sedges can be burnt as fuel and could have entered the site as animal dung or may have been deliberately brought to the site to be used as matting or binding material.

Palynology

Pollen spectra of cultural horizon VII (1.6–1.9 m depth) contain up to 65% pollen grains of trees and shrubs, predominantly *Pinus* (50%) and *Cedrus* (5%) (Fig. 8). The occurrence of *Quercus*, *Celtis, Alnus, Betula* and Anacardiaceae was noted. Herbs are represented by Asteraceae (Asteraceae, Cichoriaceae, *Centaurea*), Chenopodiaceae, *Ephedra* and Primulaceae. Polypodiaceae were rarely found.

The spore-pollen spectrum (1.25 m depth) from cultural layer VI, contained *Pinus* (50%), but of the arboreal group, *Quercus, Celtis, Pistacia, Salix* and *Betula* were rarely found (Fig. 8). Herbs are represented by *Artemisia*, Asteraceae, Chenopodiaceae, Poaceae, Papaveraceae and

Fig. 7 Phytolith analysis of samples from Baaz: **a** Weight %, **b** comparison of number of monocotyledons with dicotyledons/gm, **c** number of rondels/gm, **d** number of bilobes/gm, **e** comparison of total reeds/bulliform leaf phytoliths/gm, **f** number of Cyperaceae phytoliths/gm



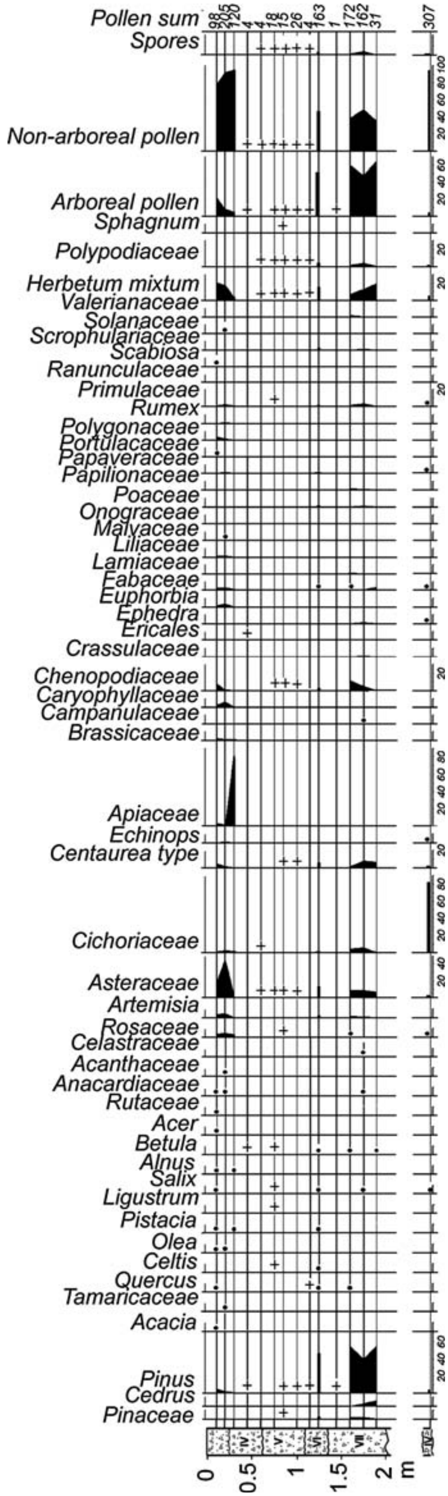


Fig. 8 Pollen diagram from archaeological strata at Baaz–cultural horizons indicated

Primulaceae. Layer V and most of layer IV (0.45–1.15 m depth) yielded few pollen grains (Fig. 8).

Pollen spectra from the upper part of layer IV (0.3 m), and a separate sample corresponding to the same layer IV, demonstrate a predominance of herbs (90%) along with a high presence of Cichoriaceae and Apiaceae and a smaller presence of Rosaceae, *Centaurea, Echinops* and *Ephedra* (Fig. 8). Trees are represented by *Pinus, Pistacia, Alnus* and *Salix.*

The upper interval of the Baaz section (0.1–0.2 m) contains a high quantity of nonarboreal pollen grains (80%) and a predominance of Asteraceae, Caryophyllaceae, Chenopodiaceae and Polygonaceae (Fig. 8). *Artemisia* and Rosaceae pollen are present in somewhat larger percentages than in earlier levels. Single grains of *Pinus, Acacia, Quercus, Olea, Pistacia* and Rutaceae are recorded in the arboreal group.

Discussion

The palaeovegetation models of van Zeist and Bottema (1982, 1991) indicate that for some millennia during the last glacial, the interior of the Near East, including the Damascus region, was dominated by *Artemisia*-Chenopodiaceae steppe and desert-steppe. Grasses, however, made up a smaller component of the steppe than they did in later periods. Despite the enormous diversity of potential food plants in this steppe, many would have been restricted to moister soils. According to Hillman (1996) the mean energy per unit area of this steppe was probably low. The Baaz charcoal data, represented as they are by Chenopodiaceae, *Artemisia* and *Amygdalus* fragments, do not contradict this reconstruction. The small amount of charcoal remains found, especially within stratum V which is relatively rich in artefacts, may indicate a general scarcity of woody vegetation through the Pleistocene, suggestive of dry conditions. The pollen data from stratum VII and VI at Baaz indicate the presence of much *Pinus* pollen, which may correlate with relatively moist conditions as were visible in the Soreq Cave record (Bar-Matthews et al. 1999). The *Pinus* peak does not necessarily represent the local vegetation, since pine pollen can be transported over longer distances, but it probably reflects its relatively high occurrence in the wider surroundings during this period. Also, in Huleh and Ghab, pine peaks occurred some time after the radiocarbon dates of 42590 B.P. and 45650 B.P. respectively, possibly corresponding to the period of increased moisture. *Quercus* pollen is present in the Holocene as well as in the Pleistocene samples, but *Quercus* charcoal was not found in any of the Holocene samples, suggesting either that the pollen was transported to the site from a greater distance or that there was a strict selection in the use of firewood by people using the site. In any case, *Quercus* pollen is represented in a much smaller proportion in the inland Baaz samples than in the more westerly Huleh basin (Weinstein-Evron 1990). *Cedrus*, *Celtis* and *Betula,* may also have been transported over vaster distances, while the *Salix* pollen may have come from the local wadi borders. *Populus/Salix* charcoal was also found within the Pleistocene charcoal samples. The pollen from stratum VI indicates slightly more arid conditions in comparison with stratum VII. Stratum V contains only few pollen grains, so it is difficult to draw many palaeovegetational conclusions from it. The lack of pollen, however, may be related to the extreme drought that occurred around 25 kyr B.P. (Bar-Matthews et al. 1999). The pollen spectrum from the sample of stratum IV, post-dating ca. 23–21 kyr B.P., contained sufficient pollen and mainly represents a steppic vegetation, probably corresponding to the Last Glacial Maximum (Robinson et al. 2006).

Due to problems with the chronology of Huleh (Meadows 2005), it is still unclear whether woodland started to expand directly after 16000 B.C. when improved conditions for plant growth occurred (van Zeist and Bottema 1982, 1991; Roberts and Wright 1993; Bar-Matthews et al. 1999), or whether there was a delay in woodland expansion until after the Younger Dryas as suggested by Meadows (2005); Robinson et al. (2006) and Rossignol-Strick (1995). The Baaz evidence cannot clarify this problem at present since well-dated evidence does not exist for the period between 23 and 21 kyr B.P. and the eleventh/twelfth millennium cal. B.C. It is however known that grasses and herbs migrated together with the expanding woodland (e.g. Hillman 1996). Therefore, whether it was directly after 16000 B.C. or after the Younger Dryas, the thin scatter of trees and shrubs would have provided important new plant-foods for hunter-gatherers. Hillman (1996) states that the annual grasses, especially wild cereals, often reach their greatest extent where the oak-Rosaceae park woodland begins to open into what is today a treeless steppe. The vegetation of the latter zone in the past would typically have consisted of pistachio-almond steppe. When further away from the border of the oak-Rosaceae park woodland, and with the possible pistachio-almond woodland steppe, wild cereals were unable to grow due to decreasing rainfall, poor soils, and increased competition.

The anthracological results from Baaz indicate that during the Younger Dryas, the site was located within the zone of the almond-pistachio steppe which was probably relatively far away from the oak-Rosaceae park woodland. At many Epipalaeolithic sites, wild almonds have been found suggesting their use as a food source (Martinoli and Jacomet 2004). Wild almonds, although toxic, have a high nutritional value if they are consumed in low quantities and in combination with meat or in combination with simple processing (Martinoli and Jacomet 2004). At Baaz however, no almonds or pistachio shells were found. Several explanations are possible for the lack of wild almonds and pistachio. The most likely explanation is that of a seasonal use of resources, due to a non-permanent settlement. As almond, and to a much lesser extent pistachio wood were used at the site, the lack of their fruits may indicate occupation in spring or early summer. It is, although less likely, also possible that the shells were removed, or that the entire fruits have been consumed in the unripe state (Hillman 2000). Alternatively, it is also possible that the investigated samples are not representative of the context. Almond and pistachio wood are high quality firewood since they are dense, dry easily and burn with a strong flame. Almond wood also produces a particularly pleasant fragrance when burnt. Among the faunal remains identified from this level, hare and gazelle dominate (Barth 2006; Napierala personal communication 2008). However, wild sheep and goat, fox, roe deer, fallow and red deer, wild horse, tortoise, wolf and birds were also found (Barth 2006; Napierala personal communication 2008). The hare and gazelle would typically have lived in the *Amygdalus-Pistacia* steppe. The aurochs, red and fallow deer indicate somewhat more forested areas west of Baaz. Sheep and goats probably lived in the cliff-line region. The finding of reed and sedge phytoliths and charcoals from *Populus/Salix* indicate the presence of a permanent water source in the area, as is still present today, which must have played an important role for the site location. Baaz must have been located away from the dense stands of wild cereals during the occupation phase in the Younger Dryas, as was indicated by the absence of oak within the samples. Poaceae remains (including a caryopsis of *Hordeum* cf. *murinum*) are present in the fruit and seed samples of this period, although in small numbers. Further north, near the Euphrates, early Neolithic sites also seem to have been located away from the optimal wild cereal habitats. It has been suggested that cereals were imported and thus that there is evidence of cultivation before domestication. This is based on the fact that founder crops there appear at different times, the find of typical cultivation weeds, a gradual decrease in small seeded gathered plants and an increased size of barley grains (Willcox et al. 2007). In Baaz, there is at present no such evidence which may be due to the fact that the site had a different function, i.e. as a camp site. Amongst the fruits and seeds at Baaz Leguminosae finds are very common.

From the Holocene onwards, moister conditions once again prevailed (Bar-Matthews et al. 1999). At first sight, the anthracological remains from the Early Holocene deposits at Baaz are very similar to those from the Younger Dryas period. *Amygdalus* again is dominating the assemblage, but no almonds have been found. The decrease in the fragment proportions of *Populus/Salix* from horizon I to III, may be related to the fact that better firewood was available in the Early Holocene. An alternative explanation could also be that the *Populus/Salix* finds may relate to the architectural structure that was found in level III but not in level I. The analysis of temporal fluctuations in Pooid and Panicoid phytoliths suggests that conditions were wetter during the Holocene than in the Natufian period, although this pattern may also reflect plant procurement strategies. The sedge and reed phytoliths indicate that the permanent water source was available. The faunal remains within the uppermost strata suggest that the vegetation was similar to that of the Younger Dryas. The fauna was again dominated by hare and gazelle, but aurochs, sheep, goat, fallow and red deer, wild horse, tortoise and wolf were also found (Barth 2006). No Poaceae remains were found from level I and II, suggesting that no seed plants were consumed at the site. Few artefacts have been found related to plant food preparation, suggesting that the site was not permanently occupied in the Early Holocene and may have been a hunting post (Barth 2006). This is supported by the retrieval of El-Khiam points from this level.

The palynological results from the upper 25 cm at Baaz generally support the vegetation reconstruction for strata I-III, though there may be some recent disturbances and poor pollen preservation. Although the insect pollinated Rosaceae, to which *Amygdalus* belongs, are generally underrepresented within pollen diagrams, they were present in a relatively large proportion within the pollen. The absence of Poaceae pollen supports the interpretation based on the anthracological results that the site must have been located some distance away from dense stands of wild cereals. The *Quercus* and *Olea* pollen probably derived from a distance. Besides Rosaceae, quite a lot of herbs and shrubs were present in the Early Holocene and Holocene stratra.

Conclusion

The palynological remains from the lowermost horizons at Baaz suggest that the site was occupied during the moist peak, between ca. 34 and 32 kyr B.P. when pine expanded; during the drought peak between ca. 23 and 21 kyr B.P., and during the Last Glacial Maximum when possibly steppe vegetation occurred within the surroundings. The nature of the occupation is not totally clear because work is still in progress.

If we compare horizon I with horizon III from Baaz, our results indicate that the Younger Dryas did not have an extreme impact on the woody vegetation of the Baaz surroundings. Alternatively, the vegetation in the Early Holocene did not fully establish itself as well as it did before the Younger Dryas. The latter has also been indicated in the Huleh pollen diagram, if only minimal reservoir corrections are necessary, as suggested in Cappers et al. (2002). For the Younger Dryas, as well as the Early Holocene, vegetation in the Baaz surroundings is reconstructed as *Amygdalus-Pistacia* steppe. Slight differences between the charcoal proportions from horizons III and I suggest, however, that the vegetation was somewhat less lush during the Younger Dryas. During the Younger Dryas and the Early Holocene, Baaz seems to have been located just outside of the range of the dense stands of wild cereals. Some Poaceae were found within the Natufian occupation. However, no particular use of grass seeds could be concluded from the samples of this period. In the later layers (I–II), no Poaceae remains were found. This indicates that the site was more probably a temporary hunting post than a plant processing site. However, the archaeological remains from the Natufian, including architecture, grinding equipment, in situ fireplace and a diverse spectrum of artefacts, indicate that the site was somewhat more permanently occupied than during later periods. The perennial springs near Baaz must have played an important role in the location and function of the site.

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