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The early Upper Paleolithic occupations at Üçağızlı Cave (Hatay, Turkey)

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ABSTRACT

This paper summarizes results from excavations at Üçağızlı Cave (Hatay, Turkey) between 1999 and 2002 and 2005. This collapsed karstic chamber contains a sequence of early Upper Paleolithic deposits that span an interval between roughly 29,000 and 41,000 (uncalibrated) radiocarbon years BP. Lithic assemblages can be assigned to two major chronostratigraphic units. The earliest assemblages correspond with the Initial Upper Paleolithic, whereas the most recent ones fit within the definition of the Ahmarian. Substantial assemblages of stone tools, vertebrate faunal remains, ornaments, osseous artifacts, and other cultural materials provide an unusually varied picture of human behavior during the earliest phases of the Upper Paleolithic in the northern Levant. The sequence at Üçağızlı Cave documents the technological transition between Initial Upper Paleolithic and Ahmarian, with a high degree of continuity in foraging and technological activities. The sequence also documents major shifts in occupational intensity and mobility.

Introduction

Üçağızlı Cave[1] is located on the Mediterranean coast in the Hatay province of south-central Turkey (Fig. 1). The site presents an unusually detailed picture of behavioral change and continuity during the early phases of the Upper Paleolithic in the Mediterranean Levant. Its stratified cultural deposits date to the early Upper Paleolithic (EUP), the interval during which anatomically modern *Homo sapiens* dispersed within western Eurasia, replacing or swamping endemic human populations such as the Neandertals. The Upper Paleolithic deposits preserved within Üçağızlı Cave span a period of approximately 12,000 years within Marine Isotope Stage (MIS) 3. AMS radiocarbon dates on wood charcoal (and some of marine shell) indicate that the sequence of layers in Üçağızlı Cave represents the temporal interval between roughly 41,000 and 29,000 uncalibrated radiocarbon years BP. Two principal cultural components are represented in the site. The earliest of these (Kuhn et al., 1999, 2004) corresponds to the so-called Initial Upper Paleolithic (IUP) phase, equivalent to "transitional" or Emirian industries previously identified in other Levantine sites to the south of the study area. The second, more recent component (Kuhn et al., 2003) closely resembles the Ahmarian complex known from other sites in the Levant. The cave also contains remnant Epipaleolithic deposits which are not discussed in detail here.

The bulk of the material reported in this paper comes from excavations conducted at Üçağızlı between 1999 and 2002, with supplemental observations from later years, especially 2005 in the case of layer I. The assemblages of lithics, ornaments, and fauna from Üçağızlı are too large and varied to describe completely in this article. Our objective is to present a general picture of the site, its contents, and findings to date. To this end we report a range of basic information about intact features, faunal remains, and a variety of artifact classes—chipped stone artifacts, cobble tools, bone tools, and ornaments. The results obtained thus far bear on a number of current questions in Levantine prehistory, including the relationship between the IUP and Ahmarian technocomplexes, the role of ornamentation in early Upper Paleolithic cultures, and dietary change in the late Pleistocene.

The site in historical context

Systematic research on Paleolithic archaeology in the Hatay Province began in the late 1950s and 1960s, when M. Şenyürek and E.

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[1] Pronounced *ewch-ah-zluh*.

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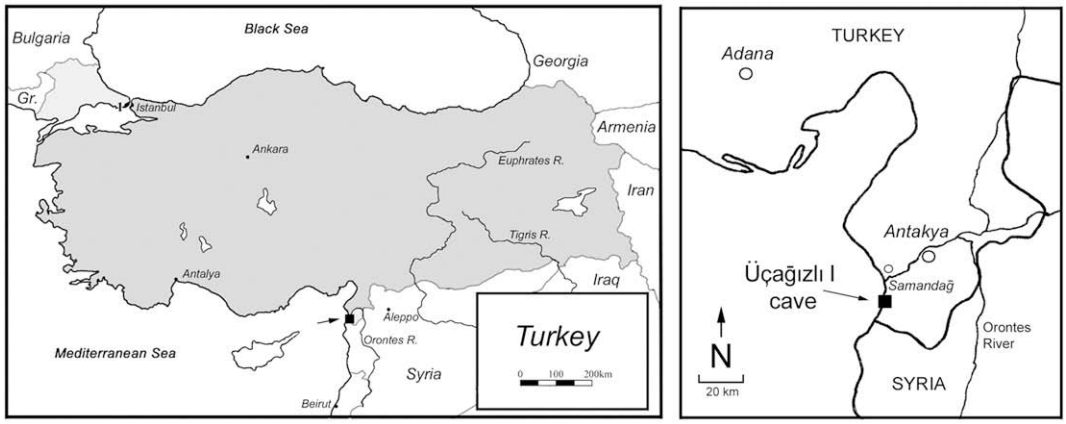

Fig. 1. Location of Üçağızlı Cave.

Bostancı carried out excavations at a series of Paleolithic sites around the coastal town of Çevlik, north of the Asi (Orontes) River delta (Şenyürek and Bostancı, 1958a,b; Bostancı, 1968). Two of these sites, Merdivenli and Tıkalı caves, preserved intact Middle Paleolithic deposits despite considerable disturbance during the Classical era. A third site, Kanal Cave, was severely damaged when a huge drainage canal was cut through it in order to divert floodwaters around the late Roman city of Seluccia ad Peirea. The remnant Pleistocene layers in Kanal Cave nonetheless provide evidence for both Middle Paleolithic and early Upper Paleolithic occupations in the area.

Üçağızlı ("three mouths") Cave is also located on the Hatay coast (Fig. 1) about 15 km south of the Asi River mouth. The coast becomes very rugged south of the Asi River, and the terrain around Üçağızlı is particularly dramatic (Fig. 2). The cave is perched on a limestone promontory at an elevation of about 18 m above the sea. The coastal topography is quite steep, such that the sea floor reaches a depth of 200 m within 5 km of the modern shore, and upwelling currents disturb the sea surface less that 1 km from shore. As a consequence, the site itself would have been situated within a few kilometers of the shore even during periods of low sea level during MIS 3 and 2. However, the coastal plain created by the Asi River delta north of the site may have expanded considerably during periods of low sea level.

Üçağızlı is a breached phreatic tube, the roof of which has collapsed. The site was once a large, elongated chamber oriented perpendicularly to the shoreline with at least one chimney opening to the slope above. The chamber may never have been fully enclosed during the period of human occupation, although the opening on the seaward side became much larger after the vault collapsed. Breccias containing bones, shells, and retouched bladelets and a bladelet core—indicative of an Epipaleolithic occupation—adhere to the back wall approximately 3 m above the current surface of the deposits, suggesting that the vault collapsed in the terminal Pleistocene or Holocene. The loss of the 3 m of Epipaleolithic or late Upper Paleolithic deposits to erosion did have the consequence of making the rich early Upper Paleolithic levels easily accessible[2]. Erosion—through undermining of the sediments at the base by wave action and by water flowing in through the breached roof—has also removed a substantial volume of deposits east of the cave mouth; the western edge of our excavation trench is close to the edge of the intact deposits.

Üçağızlı Cave was discovered and first excavated by A. Minzoni-Deroche during the 1980s. Minzoni-Deroche worked at the site over several seasons, mainly in the tubular southern chamber (Fig. 3), though she placed at least one small sondage in the northern area as well (Minzoni-Deroche, 1992; Minzoni-Deroche et al., 1995). Minzoni-Deroche's excavation exposed roughly 1 m of heavily cemented Upper Paleolithic deposits in the southern chamber. These deposits appear to correspond to the uppermost part of the sequence (layer B in particular) in our excavation at the

Fig. 2. Coastal topography in the vicinity of Üçağızlı Cave.

[2] In some early publications (e.g., Kuhn et al., 2004) we reported that layer I likely contained a low density Middle Paleolithic occupation. As the sample grew larger, it became clear that this was in fact an early Upper Paleolithic assemblage exclusively.

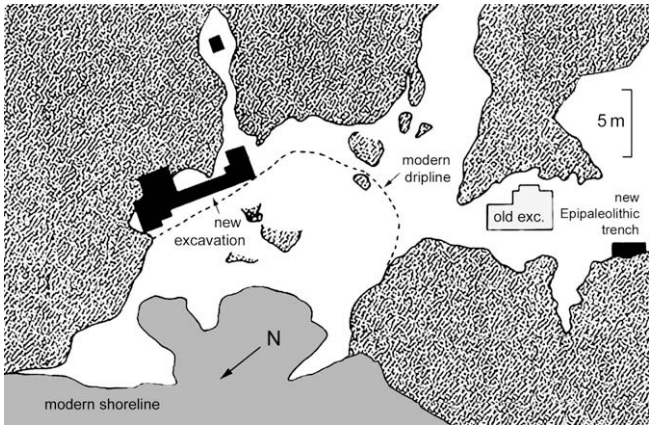

Fig. 3. Site plan for Üçağızlı Cave. Archaeological samples discussed in the text are from the large new trench in the north end of the site.

northern part of the site. Unfortunately, a steep colluvial slope deposit cut the cultural sequences in the middle of the cave, preventing direct stratigraphic correlation between the two excavated areas.

The second excavation campaign at Üçağızlı Cave has been conducted as a joint project of Ankara University and the University of Arizona. Our excavations began in 1997 with three small exploratory trenches spread across the length of the site, followed by full-scale excavations from 1999–2002 (see Fig. 3). Work has continued on a smaller scale since 2003, but those results are not reported here with the exception of material from Layer I. Excavations targeted the north end of the site, where a much deeper stratigraphic sequence is preserved along what was once the back wall of the cave. Sediments in the north end extend to a depth of more than 4.5 m. Early Upper Paleolithic cultural materials are abundant in the uppermost 3.5 m, but very scarce below this depth. A small excavation was also carried out in the southern chamber to investigate remnant Epipaleolithic deposits there and obtain comparative samples from Minzoni-Deroche's trench.

Our main excavation trench was 10 m in length and 1–4 m wide, following the rim of the remnant deposits. The excavation is deepest at the two ends, especially the north end where the sediments were more friable. Moreover, significant portions of the most recent Upper Paleolithic layers were lost to erosion at the southern end of the same trench, though the earlier layers are represented there. The north and south ends are linked by a narrow trench through highly cemented deposits. It proved impossible to follow every fine stratigraphic unit across this 10 m span. The sequences at the north and south ends of our trench are roughly comparable, but we treat them separately. Because the EUP sequence at the north end of the trench is both richer and deeper, we will focus mainly on results from that part of the excavation unless otherwise specified.

Geology, stratigraphy, and dating

The Üçağızlı stratigraphic sequence (Figs. 4 and 5) is dominated by the rhythm of human activities within the cave. The primary geogenic component throughout the sequence is reddish clay or silty clay (terra rossa) typical of limestone and karstic terrains in the Mediterranean. The accumulation of clay in the site is punctuated by wood ash lenses and dumps and concentrations of artifacts, shells, and bone (Fig. 5). Since the lithology of the sediments is comparatively homogeneous, stratigraphic distinctions are based largely on changes in the abundance and character of anthropogenic elements.

Macroscopically, layers B, C, E, G, and I are dominated by terra rosa clay, with relatively minor admixtures of ash, charcoal,

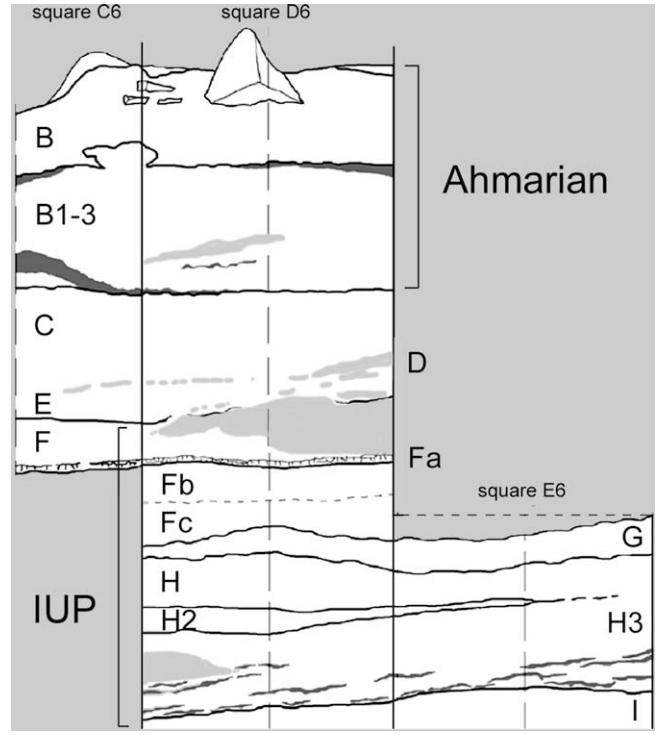

Fig. 4. Schematic stratigraphic section of Üçağızlı Cave I based on the northern excavation trench.

artifacts, bones, and shells. The anthropogenic signal is much stronger in sediments from layers B1–3, D, F, Fa, Fb-c, H, and H1–3; which range from massive ash deposits to finely superimposed ash and charcoal lenses separated by clay bands. The abundance of ash and other material introduced by humans suggests more intense or continuous use of the cave. It is possible that varying rates of clay input to the cave also influenced the relative amounts of clay and anthropogenic sediment in different layers, but we have no

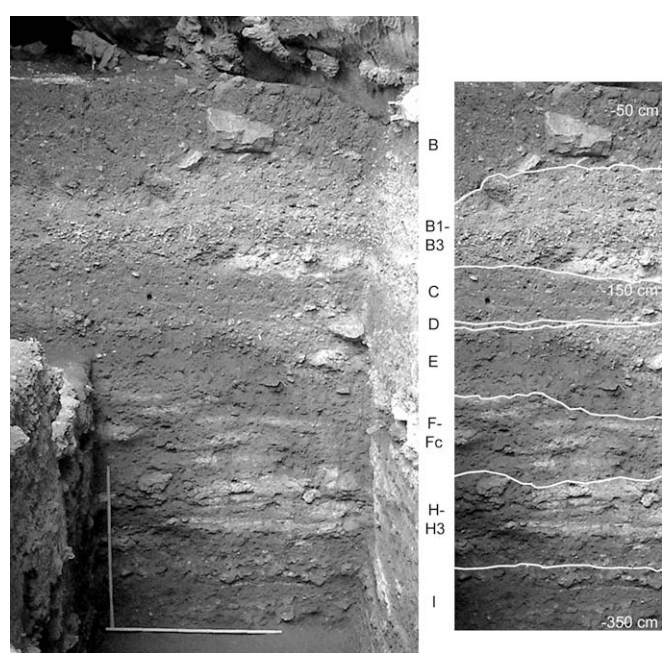

Fig. 5. Stratigraphic section of the north wall at the north end of the main excavation trench, with layer boundaries indicated on right.

absolute scale from which to evaluate this. Goldberg (2003) provides more specific observations on the micromorphological characteristics of some of the deposits.

As with any cave sequence, there were certainly intervals of non-depostion or sediment loss during the sedimentary history of Üçağızlı Cave. The I/H3, F/E, and C/B1–3 contacts are particularly sharp and level, suggesting either that deposition ceased for a time or, more likely, that the deposits were truncated by erosion. On the other hand, there do not appear to be major chronological or cultural gaps in the preserved sequence at Üçağızlı Cave.

The layers with the highest concentrations of anthropogenic materials were subdivided during excavation according to variation in the color, texture, quantity, and distributions of ash and charcoal. Subdivided layers were given designations B1, B2, and so on in the Ahmarian layers, and Fa, Fb, Fc, H1, H2, and H3 in the IUP layers. The sub-units tend to be localized and often could not be followed horizontally over more than a few meters. The finer units are combined in many of the general analyses below, hence the reference to layer groups such as B1–3, Fb-c, and H1–3.

Even among the layers that display a strong anthropogenic signal, there is considerable variation in the intensity of human occupation. In the earliest Initial Upper Paleolithic layers—H, H1–3, and the upper part of layer I—most cultural refuse occurs in flat, thin, and essentially discrete lenses, separated by thin clay bands where they are superimposed. The crisp, finely divided edges of the features suggest that the human occupations were relatively brief, discrete events. The cultural layers B1 through B3 are very different from the older layers in being dominated by a massive "midden" of wood ash, lithics, bones, and shells. These massive ash deposits are clearly the result of dumping rather than in situ burning (Goldberg, 2003).

Radiocarbon results

More than 20 AMS radiocarbon dates have been obtained for the early Upper Paleolithic sequence of Üçağızlı (Fig. 6, Table 1). Nearly all of the ^{14}C dates are on what appeared to be carbonized plant material. Additional dates from layers B and B1–3 were obtained from marine mollusk shells (*Monodonta lineata* and *Columbella rustica*). Fresh modern shells of the same species collected from a beach near the cave yielded "post-bomb" ages, suggesting that potential marine reservoir effects for these taxa are minimal in this particular environment. Table 1 and Figure 6 shows both uncorrected age determinations (Fig. 6a) and two sets of "estimated" ages. The first set of estimates (Fig. 6b) was calculated using the "CalPal" program (calpal online, quickcal2007, version 1.5, http://www.calpal-online.de); the second (Fig. 6b) was created with an online calibration program (http://radiocarbon.ldeo.columbia.edu/research/radcarbcal.htm) based on results reported by Fairbanks et al. (2005) using matched ^{14}C and U-series dates on corals. The two programs are not independent: CalPal is also based in part on the results of Fairbanks and colleagues.

As of this writing there is no single accepted calibration for the time period before 26,000 years BP (Ramsey et al., 2006: 792), and fundamental questions about the extent of offset at different intervals remain unanswered (Beck et al., 2001; Conard and Bolus, 2003; Fairbanks et al., 2005; Ramsey et al., 2006). The two systems used here are relatively conservative in their reconstructions of fluctuations in atmospheric ^{14}C. The "estimated" dates from Üçağızlı Cave are presented mainly for the sake of discussion and are not meant to be the last word on the ages of the deposits.

The radiocarbon results for Üçağızlı Cave show a general pattern of increasing age with depth. One apparent reversal early in the sequence, between layers B1–3 and C could be the result of downward movement of small fragments of burned material through the loose, ashy sediments of B1–3. More problematic is the

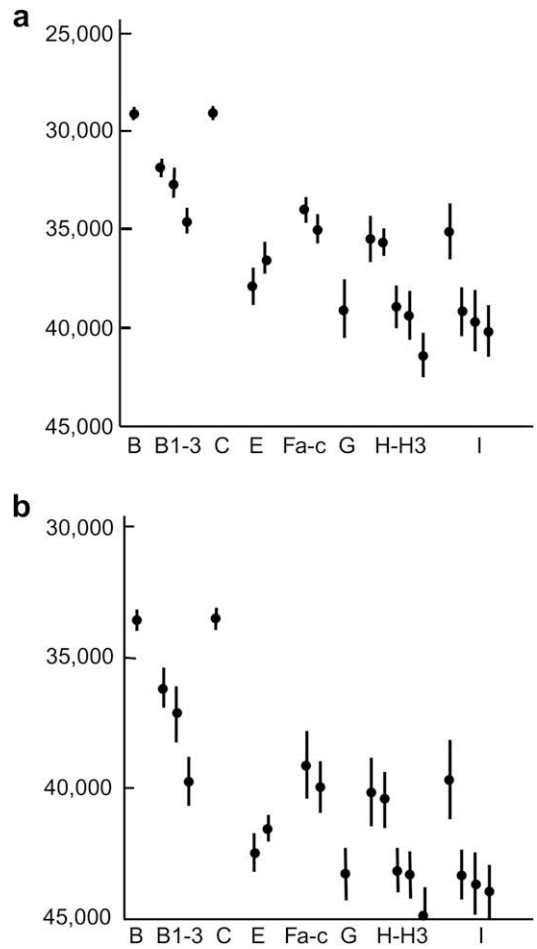

Fig. 6. Graphed raw and calibrated radiocarbon determinations for the Upper Paleolithic layers at Üçağızlı Cave: (a) radiocarbon ages as reported by the Arizona AMS Radiocarbon Facility; (b) dates calibrated using the "CalPal" on-line program.

dispersion among dates from the early part of the sequence. There seem to be two groups of ages in the earliest layers (F-I), neither of which shows a clear temporal trend. In unadjusted radiocarbon years, the younger group of dates from layers F through I fall between 34,000 and 36,000 years BP, whereas the older group falls between roughly 39,000 and 41,400 years BP. For the CalPal estimates, centroids of the younger group of determinations fall between about 39,000 and 40,400 years BP, whereas the older group of determinations falls between 43,000 and 44,000 years BP. The estimates based directly on the Fairbanks data yield a younger group between 39,000 and 41,000 years BP, and an older group of ages between about 43,000 and 46,000 years BP.

In fact, it is common for early Upper Paleolithic and terminal late Middle Paleolithic deposits to yield a wide range of radiocarbon ages when multiple determinations are obtained (e.g., Bar-Yosef et al., 1996; Conard et al., 2003; Svoboda, 2003, their Table 2.1). Such an outcome is not surprising given the lack of a calibration standard and the susceptibility of very old samples to bias from contamination with recent carbon. However, it is worth considering in more detail what the range of ages might mean in the case of Üçağızlı Cave.

Some researchers interpret ranges of age determinations as representing the period of time over which the layer was deposited. However, the overlapping age ranges of adjacent stratigraphic units in the older part of Üçağızlı Cave argue against such an interpretation. For example, layer I could not represent the entire span of time between 34,000 and 40,200 radiocarbon years BP because

Table 1
Radiocarbon dates from Üçağızlı Cave[a].

Layer	ID number	^{14}C Age	Sigma	CalPal estimate	Sigma	Fairbanks estimate	Sigma
B	AA38203	29130	380	33548	428	34525	411
B1–3	AA42320	31900	450	36190	789	37284	482
	AA38021	32670	760	37184	1087	38059	777
	AA42317	34580	620	39763	922	39936	621
C	AA42321	29060	330	33512	408	34471	368
E	AA41482	37870	920	42515	749	42881	812
	AA41483	36560	790	41566	545	41747	714
Fb-c	AA35260	34000	690	39160	1295	39372	691
	AA37624	35020	740	39989	993	40352	719
G	AA37626	39100	1500	43301	1062	43947	1315
H-H3	AA52050	35500	1200	40178	1312	40780	1121
	AA35261	35670	730	40437	1066	40954	686
	AA27995	38900	1100	43185	847	43771	971
	AA27994	39400	1200	43367	896	44260	1059
	AA37625	41400	1100	44927	1100	45950	979
I	AA52055	35100	1400	39682	1542	40400	1321
	AA52051	39200	1300	43354	943	44033	1145
	AA52054	39700	1600	43737	1193	44468	1406
	AA52052	40200	1300	44020	1079	44903	1148
I (ABOX)	AA68963	33874	271	39496	1015	39248	309
	AA68962	36915	335	41812	335	42062	338
	AA68965	39817	383	43646	599	44564	385

[a] Determinations marked "ABOX" were processed using the "ultra-clean" protocol (Bird et al., 1999). All other samples were pretreated using the standard acid-base-acid (ABA) technique. Error bars indicate one sigma. Estimated ages are determined using "CalPal" program (calpal online, quickcal2007, version 1.5, http://www.calpal-online.de) and, alternatively, the Fairbanks et al. (2005) "calibration" (http://radiocarbon.ldeo.columbia.edu/research/radcarbcal.htm). All radiocarbon determinations were made at the Arizona AMS Radiocarbon Facility, Tucson.

dates from the over lying levels G, H, and H1–3 fall into the same time range.

Contamination from humates and other organic materials is another important source of bias in older radiocarbon dates, generally causing radiocarbon ages to underestimate the true ages. Standard "ABA" (acid-base-acid) pretreatment protocol removes most organic contaminants. However, the more stringent "ABOX" wet oxidation pretreatment method has been shown to increase the maximum limits on radiocarbon ages from at least some sites (Bird et al., 1999). A series of ten samples from Üçağızlı Cave were subject to the "ABOX" pretreatment. Additionally, the samples were processed to graphite on a new, ultra-clean vacuum line constructed by Drs. Jeff Pigati and Jay Quade of the Department of Geosciences, University of Arizona (Pigati et al., 2007). Only three of the samples, all from layer I, survived the more stringent pretreatment. The ages presented in Table 1 represent means of carbon fractions collected at two heating steps (325° and 625 °C). To our surprise, the new samples showed virtually the same dispersion as the determinations obtained using the conventional pretreatment. We note that this is not always the case: at other Pleistocene sites the method can extend maximum ages back to >50,000 radiocarbon years BP (Bird et al., 1999; Pigati et al., 2007). What this indicates is that recent contamination of the types that can be removed using "ABOX" pretreatment is not responsible for the range of ages from the earliest levels at Üçağızlı Cave.

As a rule of thumb, many common factors may cause old radiocarbon dates to appear younger than their calendar ages (Pigati et al., 2007: 1–2), whereas few common factors can make them appear older. Our working hypothesis is, therefore, that the older suite of age determinations from layers F-I are closest to the actual age of the deposits. Because there is no evidence for a substantial human presence in Üçağızlı Cave predating layer I, the older set of dates could not result from inadvertently sampling carbon from older levels. Even so this suite of earlier dates probably represents *minimum* age determinations. The lack of a clear trend from layer G through I suggests that we may have reached the chronological limits of AMS radiocarbon dating under the geochemical conditions at this particular site.

The younger suite of age determinations from layers F through I may reflect post-depositional processes. One possibility is that the younger suite of ages documents a period during which some burial charcoal specimens were chemically or physically altered (see Cohen-Ofri et al., 2006), perhaps resulting in the incorporation of more recent carbon. Alternatively, it could be a result of downward filtration of small carbon fragments from levels higher in the sequence. Both "calibration" programs bring the two groups of dates closer together but do not eliminate the significant gap between them, showing that the dispersion of dates in the IUP layers at Üçağızlı Cave is not purely a problem of calibration. The broad range of radiocarbon ages in the earliest layers at Üçağızlı could also represent still more rapid, extreme fluctuations in atmospheric ^{14}C as some researchers suggest (e.g., Conard and Bolus, 2003). However, this phenomenon remains to be demonstrated conclusively.

Given the many ambiguities that currently plague radiocarbon dating for the time period in question, as well as the lack of a widely-accepted calibration curve, we will not attempt to assign precise calendar dates to individual layers at Üçağızlı Cave. We are confident that the Upper Paleolithic sequence spans approximately 29,000 through 41,500 radiocarbon years BP. Layers B, B1–3, and C appear to have been deposited between roughly 29,000 and 34,000 radiocarbon years BP. Layers G, H, H1–3, and I seem to have been created between about 35,000 and 41,400 radiocarbon years BP. These are all certainly minimum ages. Depending on the radiocarbon age and system of calibration, current estimates suggest that uncalibrated age determinations may underestimate actual ages by at least 3500–5000 years. Attempts are underway to increase the precision of age estimates using thermoluminescence and other dating methods.

Cultural features

Üçağızlı contains numerous cultural features, ranging from small hearths to massive unlaminated ash dumps. As a rule, hearths in the earlier layers (G-I) tend to be small, thin, and unelaborated (Fig. 7). These features are generally no more than 50–100 cm in diameter and consist of little more than burned patches of sediment capped by charcoal and light ash, perhaps with a shallow artificial depression. Dispersed ash concentrations in the lower

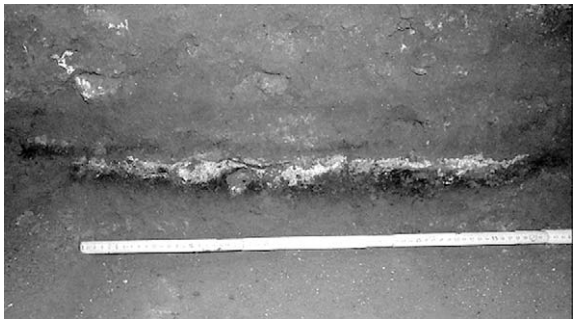

Fig. 7. Section of thin, isolated hearth feature in IUP layer I.

layers that lack charcoal or burned sediment may represent clear-out from these hearths.

No discrete hearths were identified in Ahmarian layers B and B1–3, yet ash is ubiquitous and sometimes highly concentrated. Layer B1–3 contains a massive, conical deposit of unlaminated wood ash with parallel sloping bands or stringers of flint and bone. Nearly one meter thick in places, this feature seems to represent an area where ashes and other debris were dumped repeatedly (see Fig. 5). The presence of these large ash accumulations implies the existence of substantial hearth features somewhere else in the cave, perhaps nearer the dripline in a part of the area lost to erosion.

Variation in the form and content of the thermal features over the course of the occupation of Üçağızlı Cave may reflect changes in the nature and intensity of human occupations. However, it is important to recognize that the morphology of the occupation area also shifted with time, and that only a fraction of the original horizontal extent of the deposit is preserved. The cave walls slope down to the east, away from the excavation trench, and the position of the area we sampled relative to the cave's back wall varied over the period of occupation. Sampled sediments in the Ahmarian layers (B, B1–3, C) were deposited along the wall of the cave in a place where the roof was less than 2 m above the floor. In the older layers (G-I), parts of the excavation are situated farther from the cave wall and several meters below the ceiling. It is therefore possible that the some of the perceived shifts with time from discrete thin hearths to thick ash dumps is explained by differential use of space within the cave. On the other hand, no massive ash dumps were found in the earliest IUP layers, even in the squares closest to the cave walls.

One unique feature within Üçağızlı Cave is the rock alignment found at the interface between layers B and B1–3. This feature consists of a curved array of large limestone blocks oriented generally northwest-southeast (Fig. 8). The alignment is about 2.5 m long and is only one stone deep. No other large limestone blocks were encountered in the deposit at this depth. The alignment does not correspond with any visible crack or fissure in the cave vault or pitch-point from the hill above, and we are certain that the feature is an intentional construction. White ash was concentrated between the feature and the cave wall, and the sediments were quite soft, whereas those outside (to the west of) the rock alignment contained more hard-packed red clay. A small concentration of cobble tools was located just to the northwest (outside) of the feature.

Although the rock alignment was constructed deliberately, its function remains ambiguous. No comparable features are described for other Upper Paleolithic sites in the eastern Mediterranean basin. One possibility is that the low wall delineated a bedding area against the back wall of the cave. In this case the concentration of ash might represent burned bedding material to eliminate parasites and pests. Recent examples of bedding areas along the walls of caves and rockshelters can be found in ethnographic and Holocene archaeological sources (e.g., Parkington and Poggenpoel, 1971; Gorecki, 1991; Nicholson and Cane, 1991). Unfortunately, phytoliths could not be recovered from any sediment samples from Üçağızlı Cave (Marco Madella, pers. comm.). Another possible explanation is that the rock alignment is part of a feature used for smoking meat or hides. The atmosphere is damp in the coastal region, even when the land is dry, making it difficult to air-dry meat, hides, and other materials. There is also evidence for procurement of large amounts of meat and hide throughout the sequence at Üçağızlı Cave.

Chipped stone assemblages

More than 30,000 chipped stone artifacts were recovered from the early Upper Paleolithic deposits at Üçağızlı Cave through 2002. The small Epipaleolithic sample collected from a remnant deposit separated from the main stratigraphic sequence is not discussed here. Most of these artifacts were made from flint and allied crypto-crystalline silicate rocks. Limestone and fine-grained quartzite were also flaked occasionally, and limestone and macro-crystalline volcanic rocks (diorite) were used for hammers and anvils. The crypto-crystalline silicate materials in the Üçağızlı chipped stone assemblages exhibit considerable variety in color, graininess, and fossil inclusions. We have identified potential sources—both primary and secondary—of several common flint types within a radius of approximately 30 km of the site. Cherts that occur in the Cretaceous limestone near the site are of very poor quality and are

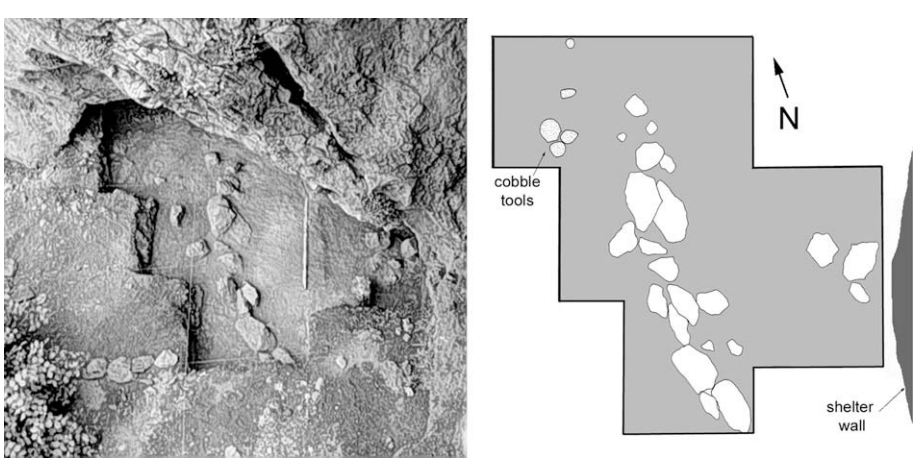

Fig. 8. Rock alignment in layer B in northern part of the main excavation trench. All large stones encountered in this layer are plotted.

practically unsuitable for flaking. The primary sources exploited by Upper Paleolithic toolmakers are more distant.

One set of flint sources exploited by the inhabitants of Üçağızlı Cave is associated with Upper Cretaceous limestone bedrock on the high plateau north and east of the site. Surface exposures near the town of Yayladağ, roughly 15 km inland of the cave, contain spherical and ellipsoid nodules up to 40 cm in length of a light grey or brown, medium-grained fossiliferous flint. A second group of bedrock flint sources occurs in Oligo-Miocene limestones 30 km or farther from Üçağızlı Cave. Surface exposures near the village of Şenköy yield relatively flat, irregularly shaped nodules of a fine-grained type, dark brown to black flint, some as large as 30 cm in length. Although the dark Şenköy flint has excellent flaking properties, it is less abundant in the Upper Paleolithic assemblages from Üçağızlı than the coarser-grained Cretaceous flints. It may be that "performance characteristics" such as toughness and edge-holding ability were more highly valued by Upper Paleolithic toolmakers.

Secondary deposits of heavily rolled flint pebbles and cobbles occur much closer to the cave, usually in fossil beaches situated inland from the modern shoreline. Two such deposits were identified within 5 km of Üçağızlı Cave, and several others located at slightly greater distances. The pebbles are generally less than 10–12 cm in length, much smaller than the nodules of the primary sources. A great range of geological sources is represented in these secondary deposits, including the characteristic fossiliferous Cretaceous flint, as well as radiolarites and other materials coming from other bedrock sources. No silicate rocks occur in the active shoreline deposits around Üçağızlı Cave. If siliceous materials were obtained nearer the site during the Pleistocene, these sources are now hidden beneath the current sea level.

Because some raw materials, including the common types of Cretaceous flint, occur both in primary and secondary contexts within 20 km of the site, chemical or mineralogical criteria are of little utility in determining where a particular specimen was collected. A simpler, but effective approach to inferring the origins of specific raw materials focuses on the nature of the cortex preserved on the archaeological specimens. "Fresh nodular cortex" refers to a soft white chalky or opaline rind that preserves its original, irregular surface. Specimens with "rolled nodule" cortex exhibit a soft, white outer layer that has been lightly smoothed or eroded by some mechanical process, presumably water transport. "Pebble cortex" displays a distinctively abraded, pitted outer surface, indicating extensive water transport and reworking: none of the original chalk or opal cortex is retained (White [1995, 1998] follows a similar approach). These criteria, along with observations of color, texture, and fossil inclusions, allow us to determine whether cortex-bearing artifacts were collected from primary or secondary sources, and in some instances, the primary source area.

Although the same main raw material source areas were exploited throughout the Upper Paleolithic occupations of Üçağızlı Cave, the degree of reliance of different raw material types and source areas varied considerably, as did the treatment of the materials according to source and type. The earliest layers (G through I) show evidence for the exploitation of both primary and secondary sources. Pebble flints from secondary deposits are represented by the full range of debitage products, from cores and debris to retouched tools. The flint material obtained from primary sources, mainly the upper Cretaceous exposures, is represented mainly as retouched tools and large blanks. The most recent layers (B, B1–3, and C) manifest a different system of exploiting of raw materials. In these layers there is very little use of the secondary pebble beds nearest the site. Instead, toolmakers tended to supply the cave with flint from primary sources. Cortex from "fresh" nodules is well represented in all stages of artifact production, from cores and debris to finished tools. The temporal variation in raw material exploitation at Üçağızlı Cave reflects different strategies of provisioning people and the site with raw materials associated with changes in the intensity and duration of occupations (Kuhn, 2004a)

Artifact samples from the 1999–2002 excavation seasons at Üçağızlı Cave include more than 3700 retouched tools and tool fragments. A broad typological breakdown for 13 stratigraphic units is presented in Table 2. We employed a slightly modified version of Hours' (1974) typology for the Upper and Epipaleolithic of Lebanon. The lithic assemblages from Üçağızlı can be divided into three broad groups. Assemblages from layers F through I correspond with what are variously called Paléolithique intermediare, transitional industries, or "Emirian" (e.g., see Garrod, 1955; Azoury, 1986; Gilead, 1991; Marks, 1992; Schyle, 1992; Bar-Yosef, 2000). The term Initial Upper Paleolithic (IUP) is preferred because it does not imply a genetic relationship with Middle Paleolithic, and because IUP industries show virtually all characteristics considered typical of the Upper Paleolithic sensu largo (Kuhn, 2003a, b). Materials from layers B, B1–3, and C at Üçağızlı instead fit within the definition of the "Ahmarian," a subsequent early Upper Paleolithic complex found throughout the Levant (Gilead, 1991; Schyle, 1992; Bar-Yosef, 2000). Assemblages from layers D and E are smaller and less easily characterized, but appear to be closer to the Ahmarian than to the Initial Upper Paleolithic. We note that the definitions of Ahmarian and Initial Upper Paleolithic used for this study may be at slight variance with those of other authors: this issue is addressed in the concluding section.

There is a striking degree of continuity in artifact forms across the entire Üçağızlı sequence (Table 2). Endscrapers are the dominant retouched tool forms in all layers, with the exception of the small sample from layer I. Retouched flakes or blades are the second most common class of artifact overall. Burins are moderately abundant in levels G, H, and H1–3, but very rare in layers B through C. Pointed blades are most common in the upper layers, less abundant in the earlier part of the sequence. No other artifact class accounts for more than 5% of the total number of retouched pieces in the collection as a whole. Unretouched pieces that correspond to a narrow formal definition of Levallois flakes, blades, and points are fairly uncommon in the sequence, except in layers H1–3 and I. However, technological attributes reminiscent of

Table 2
Distribution of major retouched tool classes in Üçağızlı Cave by layer.

Type	B	B1–3	C	C/D	D	E	F	Fa	Fb-c	G	H	H1-3	I
Levallois	0	0	5	0	0	0	16	1	23	4	8	96	21
sidescrapers and points	5	8	0	5	1	3	13	1	16	3	4	30	17
endscrapers	169	425	55	22	1	75	114	29	109	18	29	136	3
short	20	77	14	6	1	15	38	14	33	2	12	53	2
long	86	217	20	8	0	29	35	9	30	7	7	34	0
multiple	12	29	2	0	0	0	6	2	5	2	4	2	0
nosed/caren.	4	12	2	2	0	9	4	0	3	1	1	3	0
circular	7	18	5	0	0	10	3	1	5	2	0	7	0
chanfreins	0	0	0	0	0	0	0	0	0	0	0	1	7
burins	16	26	10	5	0	17	18	7	21	9	20	57	3
on fracture	2	3	3	2	0	2	1	0	3	1	1	5	0
dihedral	3	2	2	0	0	0	1	0	1	2	1	4	0
on truncation	3	8	3	0	0	5	8	3	10	4	15	38	2
perçoirs/becs	3	6	4	0	1	1	4	2	6	0	2	10	2
backed pieces	6	39	5	0	2	4	24	3	15	1	4	3	0
truncations	9	30	3	1	1	3	11	5	5	1	3	16	0
notches	12	37	2	0	0	4	4	1	4	0	1	13	1
denticulates	3	8	4	0	0	3	4	1	1	2	7	19	1
pointed blades	81	157	24	3	1	25	20	1	22	3	1	13	0
ret'd flk/bld	110	333	54	6	6	45	78	8	67	9	25	65	7
Aurig. Blades	2	1	0	0	0	0	0	0	1	1	1	1	0
pièces esquillé	3	17	8	0	2	8	10	0	10	1	1	40	0
multiple tools	7	19	1	0	0	0	5	0	6	0	1	10	0
microliths	0	3	0	0	0	0	0	0	0	0	0	0	0
divers	2	3	2	0	0	0	1	0	1	1	0	14	0
fragments	10	38	23	4	0	10	21	4	29	10	9	62	8
Total	436	1150	200	46	16	198	343	63	335	63	116	584	70

Levallois technology are quite common on both unretouched and retouched blanks in layer F and below.

Although endscrapers are the dominant tool forms throughout the early Upper Paleolithic sequence of Üçağızlı Cave, their forms vary somewhat from layer to layer. Simple endscrapers on blades are the most common types in layers B through E (Fig. 9, Nos. 1–4), although the large samples from layers B and B1–3 contain a broad range of other types, including circular and ogival forms (Fig. 9, Nos. 5–6). In layers F through H3, most endscrapers are shorter, made on thick blades with large faceted butts, and appear to have been extensively shortened or reduced from their original sizes (Fig. 11, Nos. 1–3).

Pointed blades (Fig. 11) are most common in layers B, B1–3, and C, where they account for as much as 19% of the total of retouched pieces. This class of artifact encompasses considerable morphological diversity, from very straight, symmetrical pieces to highly asymmetrical specimens that could also be described as oblique truncations. For the most part, retouch is well-developed and somewhat invasive, producing what Azoury (1986) called Ksar 'Akil points. A few specimens even approach a form that could be defined as point a face plan, such as might be found in Eastern Gravettian assemblages. A minority of the pointed and retouched blades has very fine, marginal (Ouchtata) retouch that would fit the definition of El Wad points or blades from the southern Levant. Pointed blades are less common in layer F and below and, when present, tend to exhibit different forms—often asymmetrical and verging on backed knives or points.

Burins are very scarce in the upper part of the Üçağızlı sequence, accounting for less than 10% of the retouched tools (Fig. 9, Nos. 8–10). The frequency of burins is higher in layers G, H, and H1–3,

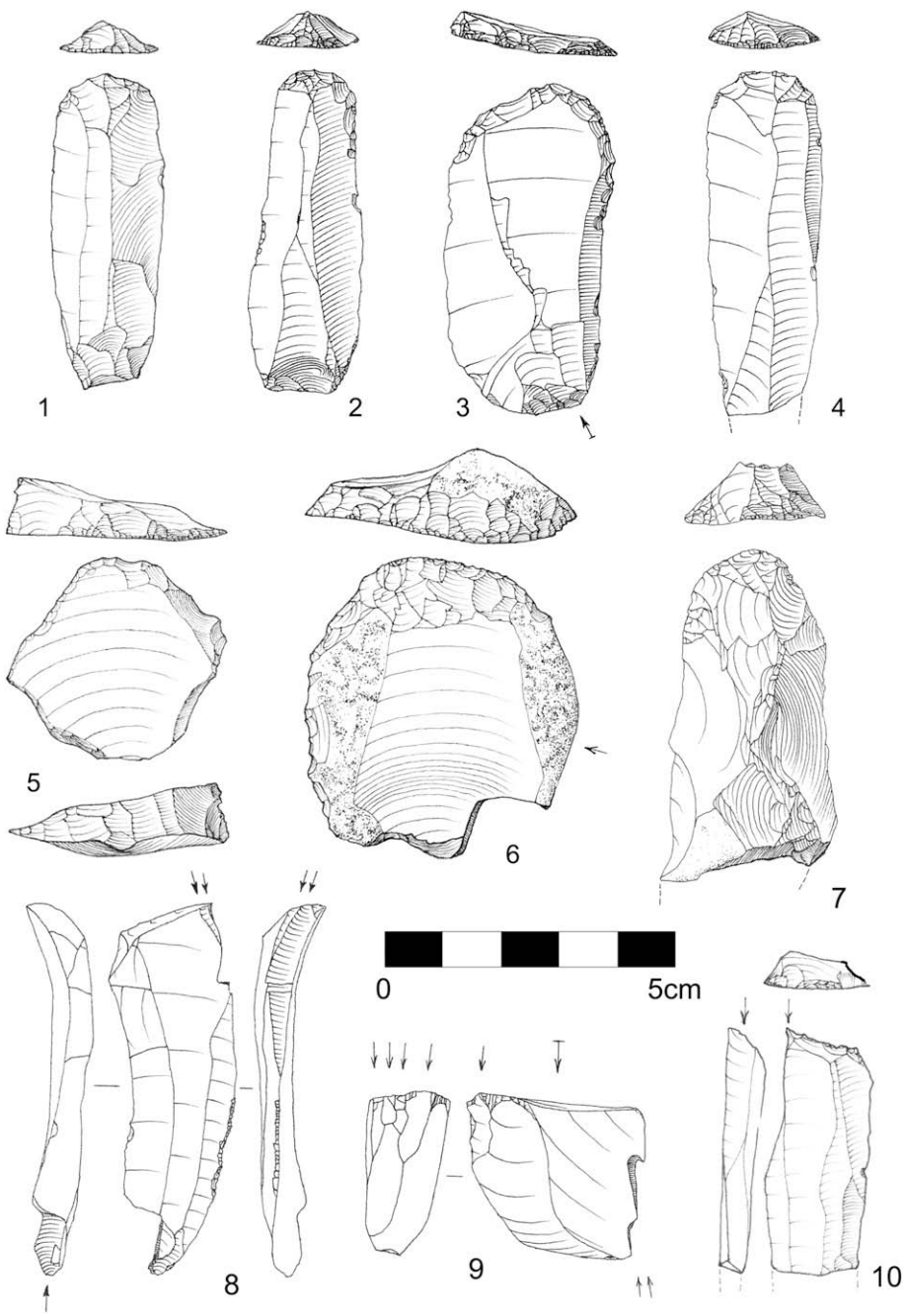

Fig. 9. Ahmarian retouched tools: (1–5, 7, 8) layer B1–3; (6,10) layer B; (9) layer C.

where they make up to 13–19% of retouched pieces. Most burins from the IUP layers are made on oblique truncations (Fig. 10, Nos. 6, 7, and 9). Microwear evidence suggests that the burins from layers H and H3 were used to work wet hide rather than hard materials like bone, antler, or wood (Martínez Molina, 2005).

One stone tool form of chronological significance is the chanfrein (Fig. 10, Nos. 12 and 13), which occurs in small numbers in the IUP of Üçağızlı Cave. Chanfreins are by definition made with a transverse, flat burin blow to a lightly prepared lateral edge. Some researchers argue that these are specialized tools, while others think that they represent a specialized technique for renewing the edges of endscrapers. Chanfreins, as well as typical flakes struck from them, are essentially confined to layer I: a single specimen comes from layer H. Chanfreins are considered 'type fossils' for the IUP or "Transitional" assemblages of the northern Levant, particularly in Lebanon (Schyle, 1992; Bar-Yosef, 2000). These artifacts have been recovered in large numbers at only a handful of sites, notably Ksar 'Akil and Antelias (Copeland, 1970; Azoury, 1986). The presence of chanfreins in the early part of the Üçağızlı sequence is another indication of chronological and cultural connections among the northern Levantine sites, a point developed below.

There is no trace of an Aurignacian assemblage sensu stricto at Üçağızlı Cave. Carenated and nosed scrapers, carenated burins, and blades with heavy invasive "Aurignacian" retouch are found throughout the cultural sequence but in very small numbers. Carenated and nosed scrapers never make up more than 12% of endscrapers, and in most layers they comprise less than 5%. No Dufour bladelets were observed, although small retouched blades and blade fragments are very common.

The stratigraphic sequence at Üçağızlı Cave documents important, subtle technological changes within the early Upper Paleolithic. These shifts are not very apparent from the frequencies of

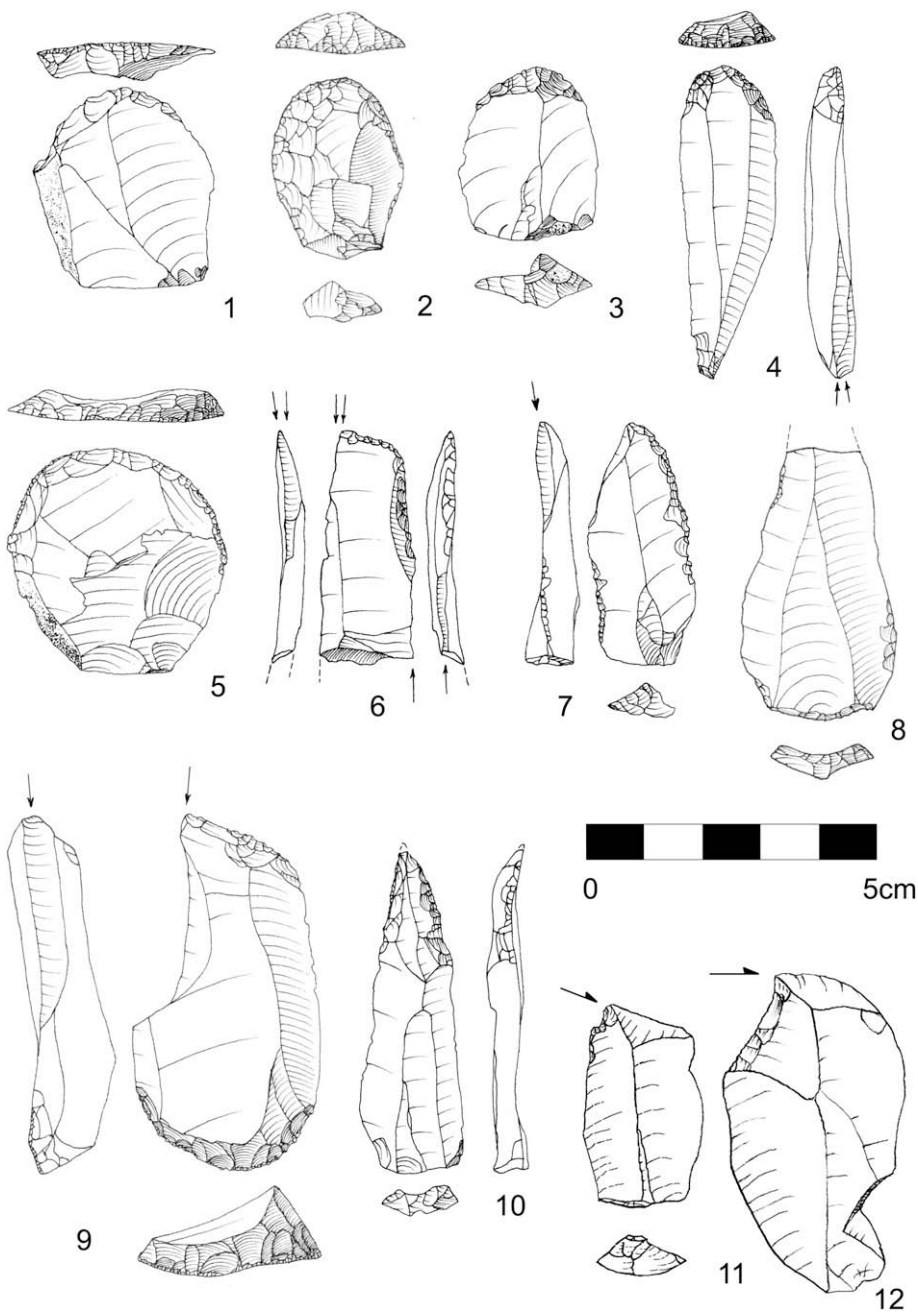

Fig. 10. Initial Upper Paleolithic retouched tools: (1–2) layer F; (3, 8,9) layer H; (4,6) layer H2–3; (5) layer G; (7, 10) layer Fb-c; (11,12) layer I.

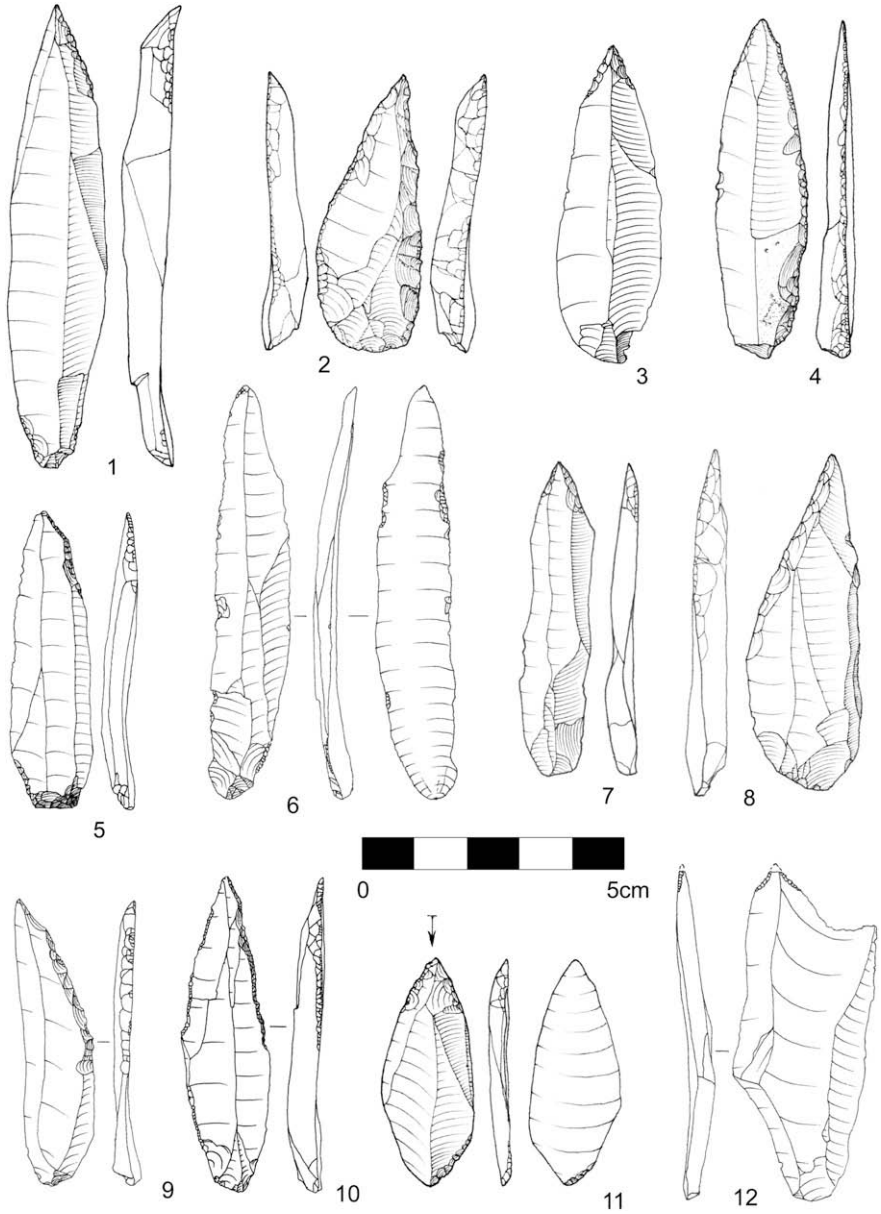

Fig. 11. Ahmarian retouched blades and points (1–4, 6, 9, 12) layer B1–3; (5, 10) layer C; (7, 8, 11) layer B.

common blank forms (Table 3). Plain blades predominate among both retouched tools and larger unretouched artifacts in all of the layers except I, although they do become slightly more common with time. As was noted above, Levallois blanks, mostly blades and elongated points, are most common in layers H, H1–3, and I, and they decline in abundance over time, essentially disappearing above layer F.

Toolmakers may have produced lots of blades over the 11,000 + years of occupation at Üçağızlı Cave, but the ways of making the blades varied considerably with time (Kuhn, 2004b). Changes in platform morphology and treatment indicate a shift from hard hammer percussion to soft hammer or indirect percussion (Table 4). In layers I, H1–3, H, and G more than 35% of larger flakes and blades possess faceted striking platforms. Plain, unfaceted platforms, the most common type, also tend to be large. Above layer F there are few faceted platforms. Instead, a large proportion of the blade blanks in layers B, B1–3, and C have very small, nearly invisible punctiform or linear striking platforms. Evidence for preparation of striking platforms by grinding or abrasion is observed on 40% to 60% of blades in layers B through E, but is essentially absent below layer F (Table 5). These contrasts in platform treatment are accompanied by more subtle morphological differences between blades from the earliest and most recent layers. For instance, bulbar surfaces on blades from layers B through C tend to be flat, whereas those from layers G through I normally have very pronounced bulbs.

The orientations and origins of scars from previous removals on the dorsal surfaces of blades from Üçağızlı Cave indicate that shifts in techniques of blade manufacture were accompanied by changes in the geometry of blade cores. In the early levels, most blades have unidirectional parallel or slightly convergent dorsal scar patterns with previous removals originating at the proximal end of the specimen. Above layer F, however, there is greater balance in the frequencies of unidirectional and bidirectional scar patterns, the latter characterized by previous removals originating at both the proximal and distal ends of a piece.

The changes in dorsal scar and platform attributes within the sequence at Üçağızlı Cave indicate a substantial reorganization of blade production technologies, corresponding with the shift from

Table 3
Distribution of major blank forms in Üçağızlı Cave by layer.

Blank	B	B1–3	C	C/D	D	E	F	Fa	Fb-c	G	H	H1–3	I
Indeterminate	294	647	88	36	14	126	327	31	197	68	123	553	91
Cortical	43	92	38	12	1	38	89	9	20	25	42	204	34
Ctx. backed flk.	5	24	22	6	1	8	54	3	33	11	22	63	19
Ctx. backed bld.	22	54	25	7	2	17	83	2	42	8	31	91	11
Plain flake	261	660	137	47	24	139	355	47	238	61	150	515	138
Plain blade	808	2197	299	77	52	316	673	98	448	133	263	696	66
Levallois flake	0	1	7	0	0	1	4	5	10	5	9	34	14
Levallois blade	1	0	3	0	0	6	54	4	56	19	38	118	25
Levallois point	1	0	1	0	1	1	13	2	10	4	4	12	5
Pseudo-Lev. pt.	0	0	1	0	1	1	0	0	1	0	0	7	8
Crete	24	89	19	4	6	43	69	5	57	9	14	53	5
Bord nucleus	14	11	6	1	1	2	18	2	20	2	2	19	13
Core tablet	12	46	8	8	0	10	7	0	7	1	3	7	1
Kombewa	0	2	0	0	0	1	4	0	1	0	0	2	0
Burin spall	4	9	4	1	0	4	11	1	11	6	15	30	2
Chunk	5	7	4	0	0	5	5	0	4	4	4	17	2
Nar Ibrahim	0	1	0	0	0	0	0	0	0	0	0	1	1
Change of orient.	4	14	2	1	0	2	4	0	1	1	0	2	0
Chanfrein flake	0	0	0	0	0	0	0	0	0	0	0	0	11
Total	1497	3855	664	198	103	720	1746	215	1219	351	721	2424	446

IUP to Ahmarian. In the IUP layers (F through I), the dominant mode of blade production bears many features of Levallois technology, including the use of hard hammer percussion and platform faceting. Most cores from these layers have relatively flat faces of detachment and preserve remnants of a single, faceted striking platform (Table 6, Fig. 12, Nos. 5–7). When multiple platforms are present, the two faces of detachment are generally offset from one another; one platform usually was used to detach flakes or blades from a broad core face, while the other platform was used to strike blades from a narrow face. This latter type of core is especially common in layers F through Fc.

Blade production in the Ahmarian layers at Üçağızlı Cave (layers B through C) differed substantially. The frequencies of small punctiform or linear butts, flat bulbar faces, and platform grinding suggest the use of indirect or soft hammer percussion, at least in the later stages of blade production. Frequencies of dorsal scar patterns demonstrate a shift to a predominantly bipolar (opposed platform) core geometry, and this is reflected on the morphologies of the residual cores (Fig. 12, Nos. 1–4). It should be noted that not all blanks from cores with opposed platforms will preserve negative scars from previous removals originating at both ends of the core, so that unidirectional scar patterns never disappear completely.

The technological trends described above constitute only a general description of the material. There is much additional diversity within and among the Üçağızlı chipped stone assemblages. For example, even in the earliest IUP layers not all cores can be characterized as having a Levallois form (Table 6). A significant number of cores from layer F and below have flat, unfaceted striking platforms and relatively convex faces of detachment; they differ from true prismatic cores mainly in the degrees of convexity and in evidence for shaping techniques such as dorsal ridges. The assemblage from layer C is unique in possessing a number of discoid or centripetal cores. Nonetheless, the sequence does demonstrate a robust technological trend beginning with hard hammer percussion, platform faceting, and unidirectional cores early in the sequence, shifting to soft hammer or indirect percussion and bipolar prismatic blade cores in the later part of the sequence. The change in blade production systems appears to have been relatively abrupt, at least within the limits of temporal resolution afforded by the stratigraphy. The boundary between layers E and F seems to represent a saltational technological shift (Fig. 13). In this respect, changes in core technology contrast strongly with the continuity in tool and blank forms (Kuhn, 2004b).

Lithic microwear patterns

One of the authors (K.M.) examined a sample of about 75 artifacts from throughout the early Upper Paleolithic sequence, using the approach described in Martínez Molina (2005). Overall, hide working is the activity best represented in microwear evidence on the early Upper Paleolithic artifacts from Üçağızlı Cave. Almost every specimen in a sample of about 35 endscrapers showed edge damage consistent with working dry hide. While the association of hide working with endscrapers is no great surprise, the very high proportion of edge-damaged pieces and the narrow array of functions represented are unusual. In addition, damage consistent with working fresh or wet hides was common on a sample of burins from layers G–H3. Burins are not often considered as artifacts for leather working, but in this case it appears that this was their dominant function just before they were discarded. Of course these results do not mean that hide working was the only activity

Table 4
Platform types, all blank forms, in Üçağızlı Cave by layer.

Platform	B	B1–3	C	C/D	D	E	F	Fa	Fb-c	G	H	H1–3	I
Missing	628	1461	205	66	35	246	587	84	351	105	219	753	109
Cortex	19	44	18	7	0	12	43	3	40	12	23	72	14
Plain	412	1254	257	76	39	250	472	40	295	85	172	623	132
Dihedral	88	215	49	17	6	52	111	19	110	36	59	229	40
Faceted	57	161	52	19	4	54	420	56	371	98	207	591	127
Linear	166	396	47	11	15	69	113	10	46	14	38	137	21
Punctiform	127	239	34	2	4	37	13	3	6	1	6	15	3
Total	1497	3856	667	198	103	720	1746	215	1219	351	721	2424	446

Table 5
Platform treatments (blades with platforms only) in Üçağızlı Cave by layer.

Plat. treatment	B	B1–3	C	C/D	D	E	F	Fa	Fb-c	G	H	H1–3	I
None/missing	256	596	58	15	8	69	181	30	141	43	110	264	34
Faceting	3	21	16	7	1	25	228	25	199	55	113	292	40
Grinding	218	505	110	19	16	66	23	0	4	1	0	3	0
Chip/batter	193	502	50	16	8	68	92	8	51	7	17	94	3
Total	670	1622	234	57	33	229	524	34	395	106	2240	653	77

conducted at the site, or even that it was the most common activity. This was simply the activity that left the most abundant and apparent edge damage on tools. Given the high frequencies of endscrapers in all of the assemblages, however, it would be reasonable to conclude that preparation and processing of hides was an important technological pursuit throughout the occupational sequence. This is consistent with the prevalence of large game remains in every cultural layer (see below).

Cobble tools

A total of about 36 cobble tools were recovered from the early Upper Paleolithic layers in Üçağızlı Cave. This artifact class includes hammers, anvil stones, small "retouchers," and several other forms. The artifacts generally take the form of water-rounded pebbles modified by humans as a byproduct of use rather than through intentional shaping. The majority of the cobble tools are made of a fine- to medium-grained green or gray volcanic stone (diorite); a few others are of limestone or dolomite. The geological origin of the volcanic stone is unclear, but some diorite cobbles occur in fossil beaches near the site. Cobble tools have been recovered from most strata, but about two-thirds of them (63%) come from layers B and B1–3.

Three forms of cobble tool are particularly common. The most abundant are thick, round or oval stones with evidence of battering on the ends, edges, and faces ($n = 16$; Fig. 14). Many of them have at least one flat face. Most specimens (11 of 16) also display distinct sub-circular pits or concentrations of battering marks near the center of one or both flat faces. The artifacts range from 80 mm to 110 mm in length. A few of these objects are also stained with ochre. The marginal battering on these objects indicates use as hammers. The potential significance of the facial pitting is discussed below.

A second group ($n = 8$) consists of small, flat, ovoid pebbles between 50 and 65 mm in length and 10 mm or less in thickness. The main evidence of use is a series of tiny punctiform or linear pits concentrated at one or both ends of flat-faced pebbles: normally there is damage to both faces. The linear pits are oriented obliquely to the long axis of the stone (Fig. 15). The wear on some examples is sufficient to produce beveled surfaces at one or both ends of the piece. Similar objects from other Paleolithic sites are interpreted as abraders or retouchers for flint working.

A third class of cobble tool ($n = 6$)—here termed anvils—consists of large flat stones up to 150 mm in length (possibly larger since some are broken). The anvils are characterized by the presence of a central circular pit created by repeated battering or pecking on one or both faces. On some specimens, the pit is a very well-developed circular depression up to 10 mm deep and 8 mm in diameter. On others there is little more than a circular concentration of battering marks. Several of the anvils are stained with ochre or hematite.

The distinctive pitting on both "hammers" and "anvils" from Üçağızlı Cave could reflect several uses, and none of them is mutually exclusive. Such damage can result from bipolar/hammer-on-anvil technology. However, bipolar cores and pièces esquilées are not abundant in the site. Another possible function of the larger cobble tools is for cracking bones. While the faunal assemblages show little if any evidence of bone grease extraction, which requires intensive crushing of spongy bone, forceful sectioning of articulated compact leg bones was common, along with systematic removal of medullary marrow. Ethnographic sources have shown that anvils can be important to both of these processing activities (e.g., Binford, 1978). A third interpretation is that the pitted stones were used for cracking nuts or large, hard seeds of some type. Organic residues or microwear analysis may help resolve the functions of these artifacts in the future.

Bone artifacts

In Eurasia, bone technology is generally considered a hallmark of early Upper Paleolithic cultures, although bone artifacts occur much earlier in Africa (Yellen et al., 1995; McBrearty and Brooks,

Table 6
Distribution of core forms in Üçağızlı Cave by layer.

Core form	B	B1–3	C	C/D	D	E	F	Fa	Fb-c	G	H	H1–3	I
Tested		3							1	1		7	2
Discoid	2	1	3	1			1					2	1
Centrip. Levall.		2	2										1
Lev. point core												1	
Lev. blade core		2	3				13		7	5	6	18	1
Proto-prismatic	4	5	6	2	3	9	11		4	3	7	10	5
Prismatic blade	4	12	1	4		4	3	1				1	
Pyramidal blade				1					1				
Offset platforms													
Bipolar		1	3			3			1	1		10	1
Amorphous		2			1					1		2	
Hammerstone					1						1	1	
Mixed: protoprismatic/prismatic						1							1
Mixed: Levallois/prismatic							1	1	2	1	2	1	
Mixed: Levallois protoprismatic							4		1		2	4	
Mixed: Lev. bld./bipolar prismatic							1						1
Indet. fragment							1			1	1		
Total	9	28	18	8	5	17	36	2	17	13	19	57	13

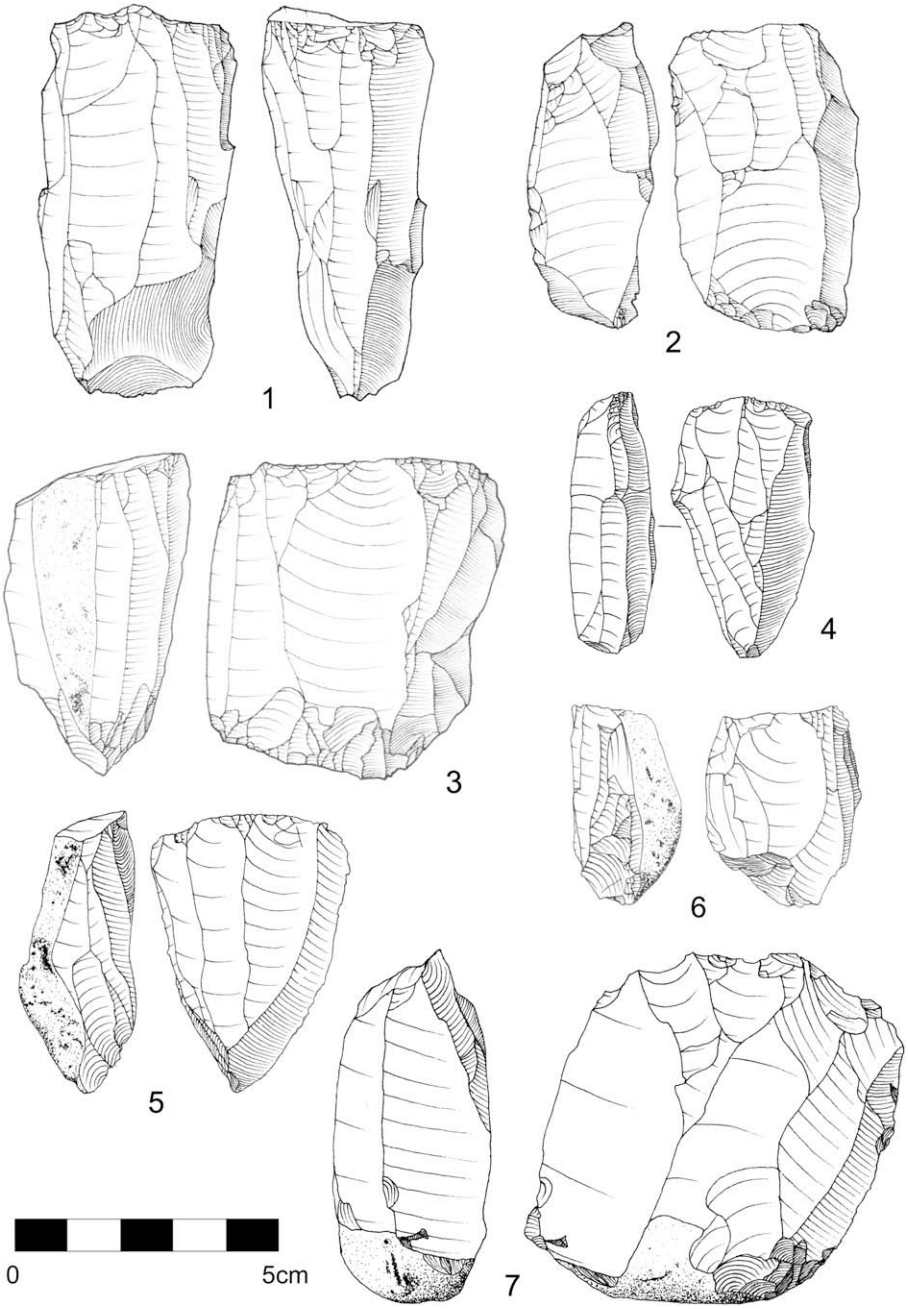

Fig. 12. Cores: (1–2) layer B1–3; (3) layer B; (4) layer C; (5) layer Fb-c; (6), layer H; (7) layer H3.

2000). Osseous artifacts are neither common nor elaborate in Upper Paleolithic sites in the eastern Mediterranean basin (Schyle, 1992). The bone and antler tools are found throughout the early Upper Paleolithic sequence at Üçağızlı (Table 7), but they are never abundant: they occur at frequencies of 1% or less of total vertebrate NISP (Table 8).

Although cervid remains are common in all of the cultural layers, most of the osseous artifacts, especially those of the IUP, were made from compact bone. The majority of the tools are pointed forms resembling needles and awls (Fig. 16). One large broken specimen from IUP layer H was made from the fibula of a large adult pig or possibly brown bear (Fig. 16, Nos. 6 and 15). This element no doubt was chosen for its convenient natural form, rigidity, and tensile strength due to the high degree of fiber alignment (see Currey, 1984: 55, 78). The thicker, unworked end of the fibula exhibits gnawing damage from a small carnivore. Though extensively worked and polished, this particular artifact may not have been part of a projectile weapon, but rather served as a decorative pin, a very large awl, or both. Most of the other artifacts more clearly served as awls, small bone points, and small wedges: the latter are made of antler.

The bone artifacts were shaped mainly by scraping or carving with minimal grinding. Evidence of girdling to facilitate transverse sectioning ("cut and snap") is not found in the sample. The distal ends of the tools (when present) typically are pointed, and some of the medium-sized and larger artifacts resemble the simple bone points described by Newcomer (1974) from Ksar 'Akil. Because the ends opposite the points are often unshaped, it is likely that many of the tools were intended for craft activities rather than as hunting weapons. In addition to the formal osseous tools, large antler sections occur in some of the assemblages, especially in layers B1–3, and may have been used as hammers; unfortunately,

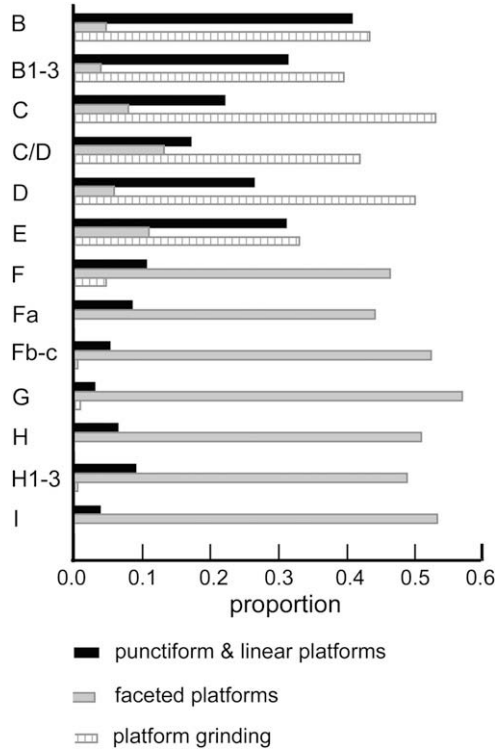

Fig. 13. Trends in the treatment of blade platforms at Üçağızlı Cave.

carbonate concretions currently obscure a detailed view of the antler surfaces.

Ornaments

The 1997–2002 excavations yielded more than 1900 Upper Paleolithic ornaments. The small sample from layer I was expanded significantly with material from the 2005 excavation season. The ornaments are concentrated at the north end of the main excavation trench, where deposits are generally richer. Almost all ornaments are beads or small pendants made from marine and freshwater mollusk shells, mostly gastropods such as *Nassarius gibbosula*, *Columbella rustica, Theodoxus*, and various *Gibbula* species. *Dentalium* (tusk) shells are common only in the Epipaleolithic sample; elsewhere in the Levant, tusk shells were used widely in the Epipaleolithic (Bar-Yosef, 1989). The only non-shell ornament comes from layer B: a terminal pedal phalanx (talon) of a very large raptor (*Gyps* or *Gypaetus*) with a notch cut into its anterior proximal end (Fig. 17).

An aggregate of damage characteristics provides fairly clear distinctions between "ornamental" shell taxa, edible or "food" species (mainly turbans [*Monodonta*] and limpets [*Patella*]), and land snails (following Stiner, 1999). There is very little overlap among these shell groups in the extent and type of human and natural modification. The ornamental shells tend to be small in size and whole or nearly so (Table 9, MNI/NISP = 98 for gastropods overall, less for tusks and bivalves). The ornamental species were often perforated with a pointed tool, and the placement of holes is very consistent. Wave-induced abrasion or surf polish is common on the ornamental shells (up to 46% of MNI), and some examples also have holes produced by mollusk predators or collision in rocky substrates. In contrast, shells of mollusks used for food are larger but highly fragmented, with sharp, crisp break edges. Shells of likely food species are never perforated by humans, wave action, or predatory mollusks.

Burning frequency and intensity do not distinguish the ornamental from the edible marine shellfish remains, suggesting that burning was accidental, occurring post-depositionally as fires were re-built in the cave (Stiner et al., 1995). Only the land snails (mainly *Pomatias elegans*, *Xeropicta* sp., *Helix cf. engaddensis*, and possibly *Oxychilis* sp.) are free of burning damage. These terrestrial gastropods are fairly common in some of the cultural layers, particularly along the cave walls. The snails appear to have entered the cave without human intervention; many of them are quite small and there is no indication of human processing damage.

Fig. 14. Pitted stone hammer from layer B.

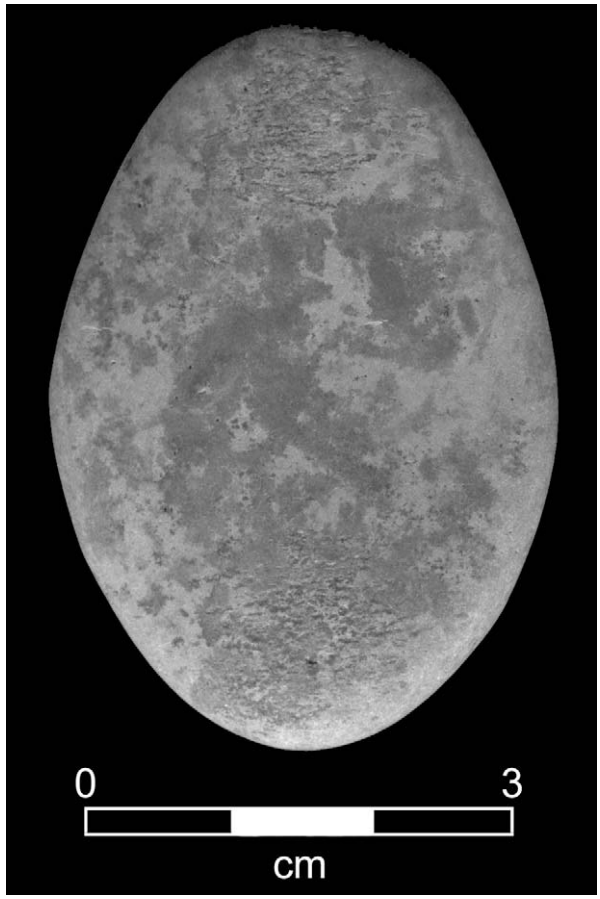

Fig. 15. Stone "retoucher" from layer B.

Ornamental gastropods were most often perforated through the flange or aperture (Fig. 18), or through the umbo in the case of small bivalves. A rarer perforation method, found on some moon shells (*Naticarius* and *Neverita*) in the Ahmarian layers, involved sawing a slit in the lip margin (Fig. 18, No. 11). *Dentalium* (tusk) shells were sectioned or snapped to create tube beads. The human-made holes in gastropod shells have irregular edges, and seem to have been made with direct pressure from a pointed object. There is no evidence that humans drilled shells using radial or reciprocating motions. As a consequence, human-made holes in shells from Üçağızlı Cave are easy to distinguish from the symmetrical, beveled openings that naticid and muricid predators drill into the shells of live prey. The latter type of damage was observed on only about 7% of ornamental shell specimens, but it does occur on most ornamental species.

The frequency of wave-induced abrasion (46% of MNI on average) and predator-drilled holes on Üçağızlı ornaments is consistent with the idea that humans relied mainly upon beach-cast raw material rather than on capturing live specimens to use as ornaments. Shells destined for ornament-making were collected

Table 7
List of osseous tools from Üçağızlı Cave by layer[a].

Layer	Form	*n* specimens
Epi	Needle	1
	Point	1
	Indet. fragment	2
B	Awl	3
	Awl/needle	1
	Indet. fragment	2
B1–3	Awl	4
	Awl/needle	1
	Point	2
	Indet. fragment	2
C	Awl	1
	Awl/needle	1
	Needle	1
	Point	1
C/D	Awl/needle	1
E	Awl needle	1
	Needle	1
F	Point/awl	1
	Polished splinter	1
	Indet. fragment	2
Fa	Point	1
G	Indet. fragment	1
H	Point	1
H3	Awl	1
Total		35

[a] Note that all terms refer to possible function based on form rather than demonstrated function.

Table 8
Proportional abundance of osseous tools to shell ornaments and large game (artiodactyl) remains in Üçağızlı Cave by layer group[a].

Layer group	Total prey count	*n* bone tools	Proportion bone tools to shell ornaments (%)	Proportion bone tools to ungulate remains (%)
EPI	519	4	9	5
B-B3	12,762	15	1	1
C-E	3334	7	5	1
F-H3	9216	8	2	0.3
I	1114	0	0	0

[a] Ungulate counts are for specimens identified to genus or species only (NISP); ornament counts are MNI. Material from the Epipaleolithic layer in the south end of the site is included for comparison. Total prey count represents all animals in the diet (NISP for vertebrates, MNI for shellfish to control for differences in the sizes of identifiable specimens) and is provided to correct for potential sample size effects on the "visibility" of bone technology in the cultural layers.

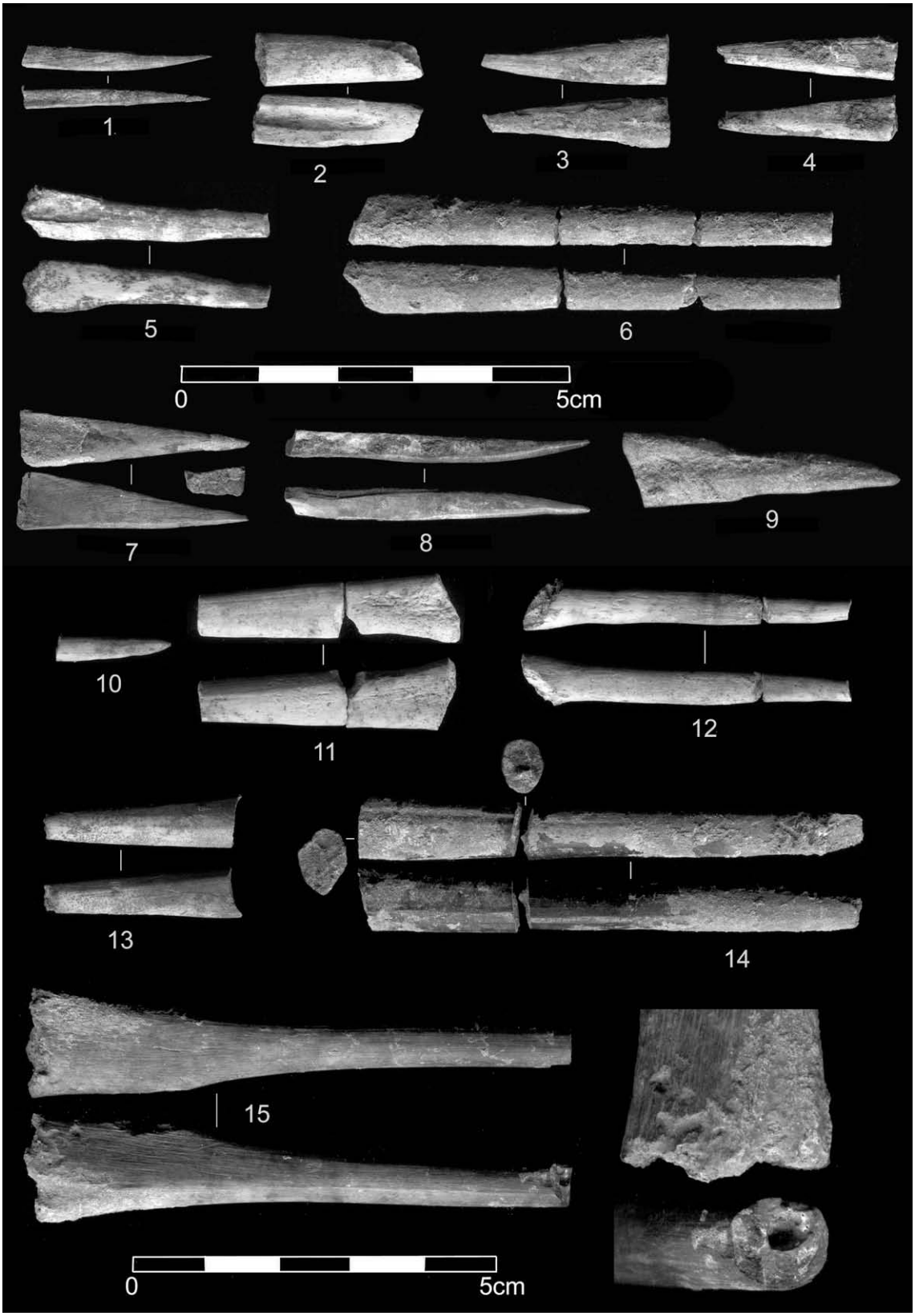

Fig. 16. Selected bone artifacts: (1–4) layer B; (5–6) layer B3; (7–9) layer C; (10) layer E; (11–14) layers F-Fa; (15) layer H. Detail insets for specimen 15 show cross-section with medullary cavity and fine gnawing damage on the unworked end.

from rocky shores, soft marine shores, and inland freshwater lakes or rivers. At least one paleontological source was used as well; the tusk shells probably were obtained from Pliocene beds located 15 km from the site (see Taborin [1993] on other examples of fossil exploitation), judging from their condition and variety. None of these shell sources was far from Üçağızlı Cave.

Although shell ornaments are present throughout the sequence at Üçağızlı Cave, there is significant temporal variation in the

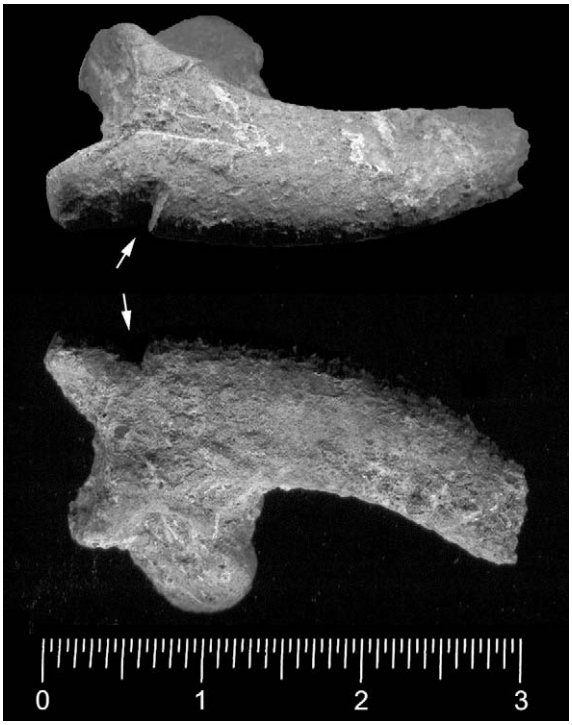

Fig. 17. Bony core of a large raptor talon from Üçağızlı Cave with an incision on the dorsal proximal surface arrow. The specimen is, probably from a vulture such as *Gypaetus barbatus* or *Gyps fulvus*.

relative importance of species from different sources. The marine species, *Nassarius gibbosula,* dominates the IUP assemblages (83–99%) but is co-dominant with another marine taxon, *Columbella rustica,* in the Ahmarian layers (Fig. 19). Freshwater types (mainly *Theodoxus* and *Melanopsis*) are most common in layers C-E, whereas the Epipaleolithic assemblage contains a more even mix of tusk shells, *Gibbula*, *Columbella*, and other types.

Taxonomic diversity in the ornament assemblages, measured using an inverse of Simpson's (1949) index, increases steadily with time, rising more than threefold from the IUP to the early Epipaleolithic (Table 10, Fig. 19). A trend towards increasing diversity is apparent for shell ornaments, regardless of whether the data are grouped by genus or broader shape categories. The diversity results separate the major culture phases. The IUP ornament assemblages are dominated by a single taxon, *Nassarius gibbosula*. Assemblages from layers E-C and the Ahmarian series (B-B3) show intermediate levels of evenness, and the Epipaleolithic assemblage is the most even.

Changes in marine environments might be responsible for the steady increase in ornament species diversity with time. Whereas the taxonomic diversity/evenness of terrestrial faunas experienced comparatively little change during the span of the late Pleistocene represented in the Üçağızlı sequence (Table 10), local forces governing aquatic habitat structural complexity might account for the trend in ornament species diversity. In particular, fluctuations in the hydrodynamics of the Orontes River mouth and the complexity of the marine shoreline could have determined the range of species available to ornament makers.

Although near-shore marine habitats undoubtedly influenced the composition of ornament assemblages at Üçağızlı Cave, some biases in taxonomic representation clearly reflect human preferences. Selectivity is apparent from the prevalence of ecologically uncommon taxa (e.g., *Nassarius* is a carnivorous scavenger), as well as from redundancy in shell shape, size, and probably also color (Stiner, 1999). In fact there is remarkable consistency in ornament shell shapes and sizes at this and other early sites, irrespective of the increasingly diverse array of taxa utilized with time. Rounded, basket- or pearl-shaped forms are especially common at Üçağızlı and in sites across the Mediterranean Rim, and perhaps over an even wider area (Stiner, 2003; Vanhaeren and d'Errico, 2006; Vanhaeren et al., 2006). *Nassarius gibbosula* or similar forms of *Nassarius* dominate the earliest ornament assemblages in North and South Africa and the Levant (Henshilwood et al., 2004; Vanhaeren et al., 2006; Bouzouggar et al., 2007), implying a narrow human preference for this particular form (Bouzouggar et al., 2007). The IUP assemblages from Üçağızlı are consistent with this tendency, such as it is. Clearly more cases suitable for rigorous diversity analysis are needed.

It is likely that Upper Paleolithic occupants of Üçağızlı Cave manufactured shell beads and/or ornamented objects there, not surprising given the site's proximity to the sea. It is significant that only some so-called "ornamental" shells at Üçağızlı actually have holes in them (67% for gastropods, fewer for tusks and bivalves). The presence of specimens broken during attempts to perforate them (see Fig. 18, No. 12) provides further evidence that many of the ornaments were produced on site. Further, the Üçağızlı ornaments assemblages lack the "high-grading" or quality-sorted effect and heavy use-polish seen at some inland Mediterranean sites. A few shell beads do appear to have been broken and abandoned after extended use, but fewer than 5% of 150 human perforations sampled in a 20× microscopy study display fine polish on edges typical of prolonged contact with fiber.

Ornamental shells are widely scattered through the deposits in Üçağızlı Cave, in and among lithic and bone debris. It appears that the these objects accumulated with other camp litter—shed or discarded gradually by individuals in a variety of contexts. The rate of ornament discard is positively correlated with the accumulation of vertebrate game remains, with the relative frequency rising only slightly in the youngest layers, and is independent of the accumulation rates for edible marine mollusks and land snails (Table 11). We did not find articulated sets of ornamental shells, as if they were deposited while still strung, but at least one very tight concentration was found in layer G, and certain other loose clusters in the IUP deposits may also represent caches of some kind. Consistent with the general pattern in the shells, not all of the specimens in caches and concentrations have holes in them, and the state of completeness and incidence of wave-induced abrasion is highly variable.

Table 9
General summary of damage frequencies for various ornament and food shell categories from Üçağızlı Cave for all layers combined.

Variable	(Ornamental) Small gastropods	(Ornamental) Tusk shells	(Ornamental) Most bivalves	(Food) Various turbans	(Food) Various limpets
Surface polish (% of NISP)	46	10	12	0	0
Completeness (MNI/NISP)	98	53	64	42	63
Perforation (% of MNI)	67	30	34	0	0
Burned (% of NISP)	10	5	10	14	4
Predated by mollusk (% of MNI)	5	0	7	0	0

Faunal remains

Microfaunal remains occur in all of the major strata, but only two assemblages from the Upper Paleolithic (layer I and layers B-B3) in the northern end of the main trench are large enough to permit analysis. Micromammal species include *Microtus nivalis*, *Microtus guentheri, Apodemus mystacinus, Apodemus flavicollis, Apodemus*

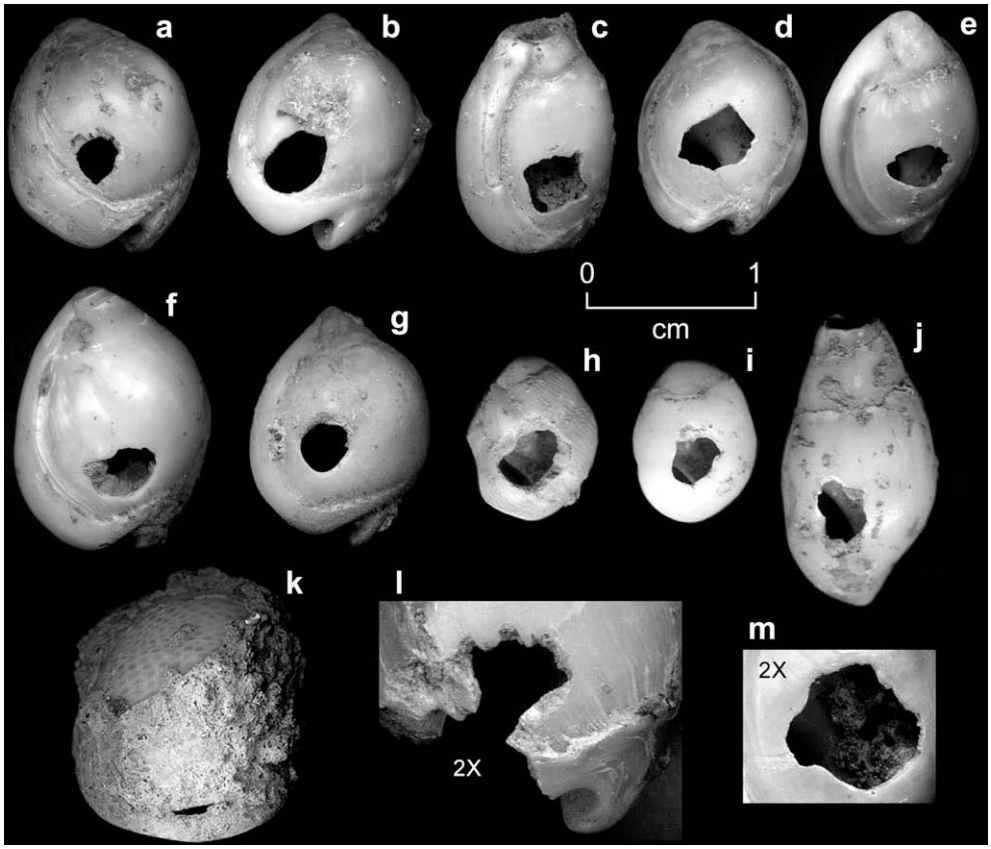

Fig. 18. Typical perforations in small marine gastropod shells (*Nassarius* [a-g], *Theodoxus* [h-i], *Melanopsis* [j]) made by humans using a simple punching technique (m, scratches from slipped tool bit). Rarely, slits were sawn into the lips of moon shells (k). Some shell flanges were broken through the perforation point (l) at the time of manufacture or in other cases from use. Polish on some specimens is indicative of cord-wear and is confined to the edges of these holes (b, g).

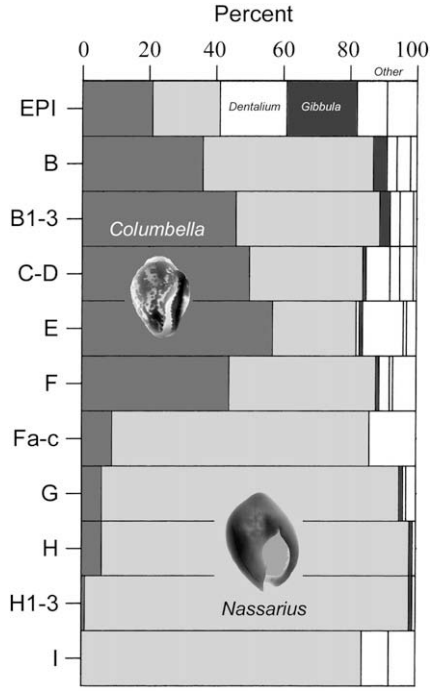

Fig. 19. Relative frequencies of *Columbella*, *Nassarius*, *Dentalium*, *Gibbula*, and other mollusk genera in the ornament assemblages by layer.

sylvaticus, *Mus abbotti*, *Mesocricetus auratus*, *Glirulus* sp., *Crocidura* sp., *Pipistrellus* cf. *kuhlii,* and *Myotis* sp. The rodents from the early Upper Paleolithic suggest the dominance of open country and rocky ground with a woodland component. No essential environmental differences are indicated during the deposition of these two layers. Shellfish also occur in both of these layers, but not in several other layers that lie between them (see below). The rodent assemblages contain a combination of European, local, and Asiatic elements. All of the rodent species from Üçağızlı, except for *Glirulus*, are also known from the pene-contemporaneous levels of Karain B (Storch, 1988) and from the extant fauna of the Hatay region.

The macrovertebrate assemblages from Üçağızlı Cave are large and well-preserved. Bone mineral preservation is generally very good, whereas collagen preservation is very poor (J. Pearson, pers.

Table 10
Species diversity variation (Inverse of Simpson's Index) in terrestrial prey categories and ornamental shell assemblages by layer in Üçağızlı Cave[a].

Layer	All Game Types (n types = 11)	Ungulate Genera (n types = 6)	Small Game Types (n types = 5)	Ornament Groups (n types = 7)	Ornament Genera (n types = 25)
EPI	0.45	0.45	0.66	0.7	0.2
B	0.28	0.53	0.28	0.35	0.1
B1–3	0.41	0.5	0.34	0.37	0.1
C-D	0.28	0.28	0.54	0.39	0.11
E	0.32	0.49	0.73	0.38	0.11
F-Fc	0.38	0.61	0.36	0.36	0.1
G-H	0.25	0.39	0.58	0.16	0.04
H1–3	0.3	0.52	0.48	0.15	0.04
I	0.37	0.56	0.45	0.19	0.05

[a] "All game types" is based on an unorthodox combination of six ungulate species and five general small game categories. The index values are further standardized relative to the number of possible categories to create a scale ranging from 0 to 1.

Table 11
Relative abundances of ornamental shells, food marine shells and land snails to vertebrate remains in the Upper Paleolithic layers of Üçağızlı Cave[a].

Layer	Vertebrate NISP	Standardized abundance:		
		Ornaments	Food shells	Land snails
EPI	519	0.08	0.17	0.14
B	3129	0.08	0.19	0.02
B1–3	9633	0.05	0.11	0.01
C-D	2398	0.04	0.04	0.04
E	936	0.05	<0.01	0.01
F-Fc	3822	0.05	<0.01	<
G-H	1813	0.05	<0.01	0
H1–3	3581	0.04	<0.01	0
I	1114	0.02	0.02	0.01

[a] Standardized abundance values for ornament, food shell, and land snail abundances are calculated as the MNI by group divided by the sum of all shell counts and vertebrate NISP. MNI counts are used for mollusks to correct for much greater identifiability and much smaller body sizes relative to vertebrates.

comm.). The Upper Paleolithic faunal assemblages are dominated by terrestrial game animals and by artiodactyl ungulates in particular (see Appendix 1 in the Supplementary Online Materials [SOM]: supplementary data associated with this article can be found in the online version at doi: 10.1016/j.jhevol.2008.07.014). The co-occurrence of up to six ungulate species in a single layer is evidence of a heterogeneous environment in the area throughout the early Upper Paleolithic. Fallow deer (*Dama mesopotamica*), bezoar goat (*Capra aegagrus*), and roe deer (*Capreolus capreolus*) were particularly important in forager diets at Üçağızlı Cave. Wild boar (*Sus scrofa*), red deer (*Cervus elaphus*), and aurochs or wild cattle (*Bos primigenius*) are present in many layers but less common overall. The mortality patterns of the ungulates are typical of the Upper Paleolithic in the Mediterranean basin and elsewhere in Eurasia (Stiner, 2005:197–218), ranging from nonselective to prime-adult biased age profiles. Preliminary tooth eruption and wear observations indicate that small sets of sub-adults, usually deer, died at about the same age. However, the mix of ungulate species in most assemblages suggests that only one or a few animals were hunted in any one episode.

The steep coastal ridges on which Üçağızlı Cave is situated give way to a well-watered coastal plain roughly 1.5 km north of the site. These plains would have been considerably wider during periods of lowered sea level in MIS 3. The promontory on which the cave is located is flanked by two deeply incised drainages that terminate in "box canyons." It is possible that these topographic features were used to block or funnel the escape routes of ungulate prey. The availability of natural traps at the interface between rich hillside and lowland pastures almost certainly explains the perennial attraction of the site for Paleolithic groups.

There is considerable variation in the relative importance of the ungulate species among Upper Paleolithic layers (Fig. 20). The opposing frequencies of wild goat and fallow deer (S_r – 0.933, p 0.001) are particularly noteworthy. The frequencies of red deer and aurochs remains are positively correlated (S_r 0.722, $0.05 > p > 0.01$) and both of these species decline in frequency over time (Fig. 20). However, there is no trend within the early Upper Paleolithic archaeofaunas with respect to taxonomic richness or evenness based on the Reciprocal of Simpson's Index (Table 10).

Some of the changes in ungulate species abundance must relate to climate-driven shifts in ambient moisture and vegetation in the coastal mountains and Orontes River delta. The entire early Upper Paleolithic sequence falls within OIS 3, the onset of which is marked by rapid, small temperature oscillations within a broader trend toward cooler conditions (Martinson et al., 1987). The importance of shellfish in the diet in some layers but not in others may relate to

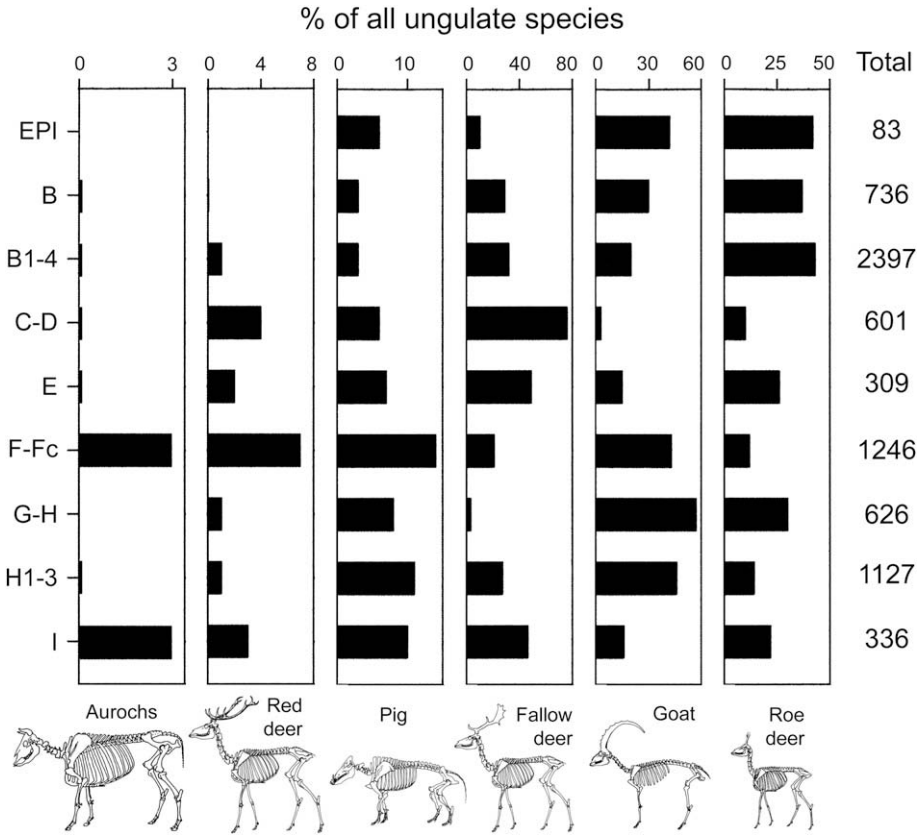

Fig. 20. Ungulate species proportions by layer group. Note that these NISP counts reflect only those specimens that could be identified to genus and therefore exclude specimens assigned to more general ungulate size categories such as "small ungulate".

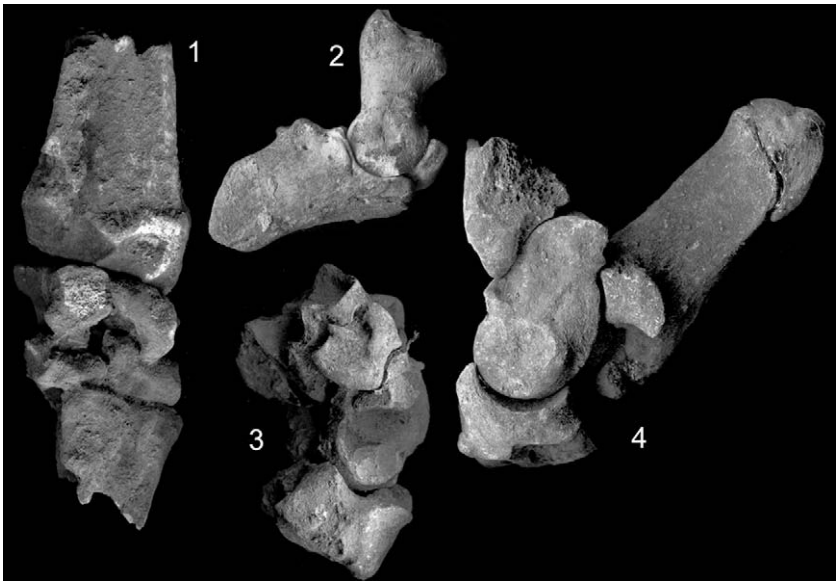

Fig. 21. Examples of transversely fractured and articulated ungulate limb and foot segments: (1) fallow deer carpal complex from layer B2–3; (2) phalanges of bezoar goat from layer Fb; (3) fallow deer tarsal complex from layer E; (4) roe deer tarsal complex from layer H.

climate oscillations as well. The horizontal distance between site and sea was always short on account of the steep topography of the coast. The vertical distance between cave and shoreline nonetheless would have varied significantly, however, with changes in sea level. Assuming that edible shellfish were most likely to have been carried into the shelter when the marine littoral was closest, the presence of shellfish in layer I and in layers D through B suggests that these layers formed when the sea level was fairly high, resource acquisition had intensified, or both. Microfauna from layers B and I also indicate similar environments. The near lack of edible shellfish in layers E-H3 would imply that the shore was farther downhill and access less convenient. The frequency of pig remains is negatively correlated with shellfish in the Upper Paleolithic series (Fig. 20, S_r – 0.825, $.01 > p > 0.001$), perhaps because oak scrub forest and other cover that pigs favor retreated uphill during warm periods.

Significant body size reduction occurred in bezoar goats between the Initial Upper Paleolithic and Ahmarian phases at Üçağızlı Cave, a trend that can be discerned for faunas from Levantine and Anatolian sites more generally (Açıkkol, 2006). The diminution trend in wild goat populations could be related partly to climate, at least prior to the Pleistocene-Holocene transition, but the phenomenon is not observed for fallow deer, red deer, or roe deer in the Üçağızlı series.

Calcite concretions obscure the surfaces of some of the specimens from layers B through E, but morphological and damage features other than cut marks are nearly always visible. Some limb segments of medium and large ungulates, particularly the carpal and tarsal complexes, have remained in articulation (Fig. 21). This suggests that post-depositional disturbance was minimal in many areas of the site. Clean transverse fractures are common on leg bones and suggest an emphasis on through-bone dismemberment rather than disarticulation at the joints. Impact cones, spiral fractures, and crushing damage are prevalent as well. The inhabitants removed medullary marrow from nearly every major leg bone and mandible of adult ungulates. The thoroughness of "cold" marrow extraction implies that the nutritional state of these tissues was quite good and that the main seasons of consumption were fall through winter. However, there is no evidence for more intensive forms of bone marrow and grease extraction, no evidence that the spongy portions of bones were pulverized or boiled in the manner described for recent foragers by Binford (1978), Lupo and Schmitt (1997), and others.

The tool marks on the ungulate bones in Üçağızlı Cave indicate extensive de-fleshing of the ungulate carcasses. Diagonal slicing marks and long axial scrapes are the most common types of cut mark, and most of these occur on the shafts of upper limb bones—the scapula, radius, tibia, but especially the humerus and femur. Some meat appears to have been filleted in preparation for smoke-drying, particularly during the later occupations. The dense ash concentration between the shelter wall and rock alignment at the interface between layers B and B1–3 may have been a structure for smoke drying meat. It is interesting that the IUP and Ahmarian layers differ with respect to the volume of wood ash residues, and that burning damage on bones and shells suggests differing contexts of fire use and debris accumulation. Charcoal is very rare in the Ahmarian layers, but thick, unstructured ash dumps are common. Charcoal is more abundant in the earlier layers where hearths are mainly thin isolated features. Burned bones occur throughout the cultural layers, but they are most abundant in the IUP. These observations suggest a different scale to the spatial organization of features and activities between the IUP and Ahmarian. Specifically, certain areas of the site had more dedicated or segregated uses during the Ahmarian occupations such that thick ash dumps, hearth concentrations, and structures (possibly for smoking meat) formed as the result of more intense use of the site.

Some of the variation over time within the Üçağızlı faunal record reflects more global changes in Paleolithic human subsistence practices. This is particularly apparent from the small game remains. Figure 22 compares the frequencies of five categories of small game animals in the early Upper Paleolithic through Epipaleolithic layers, along with a series of samples obtained recently from a sondage in a Middle Paleolithic cave nearby (called Üçağızlı II). As has been observed in other records of the eastern Mediterranean basin (Stiner et al., 2000; Stiner, 2001, 2005), there is a significant increase in the variety of small animals exploited in the early Upper Paleolithic. The Middle Paleolithic small game fraction is distinguished by nearly exclusive use of slow-moving small prey types—tortoises (*Testudo cf. graeca*) and large edible shellfish (turbans [*Monodonta*] and limpets [*Patella*]). A much more diverse combination of slow-moving and quick small game types were

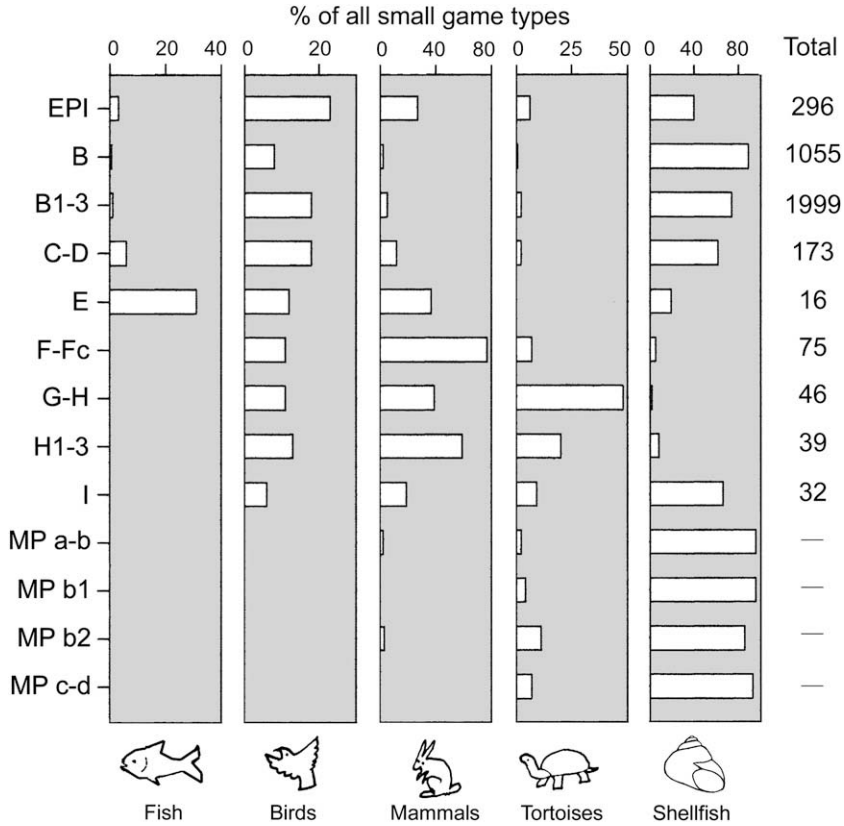

Fig. 22. Temporal variation in the relative importance of five small game categories in the early Upper Paleolithic and a late Middle Paleolithic (MP) sample from a nearby cave site. Percentages are of total small game remains in each Upper Paleolithic layer, based on NISP counts for vertebrate remains, and MNI counts for edible shellfish to correct for significant differences in skeletal identifiability. Proportion estimates for the Middle Paleolithic assemblages are preliminary but representative.

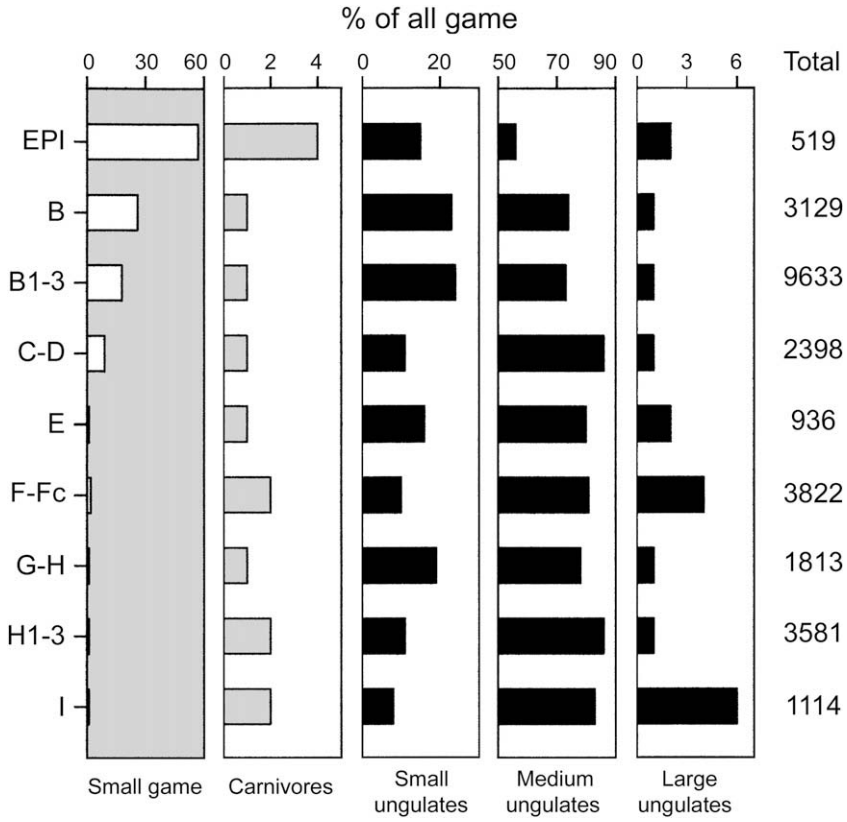

Fig. 23. Percentages game types by general categories in Upper Paleolithic and Epipaleolithic assemblages, based on NISP for vertebrate remains and MNI for edible shellfish to correct for significant differences in skeletal identifiability.

taken from the Initial Upper Paleolithic onward, including hares (*Lepus capensis*), Persian squirrel (*Sciurus anomalous*), and birds such as chukar (*Alectoris*) and raptors (the latter probably used for raw materials rather than food). Marine fish may have been added to the diet in the more recent (Ahmarian) levels. The relative contribution of small game to the total meat diet increased mildly but steadily into the Ahmarian, and then spectacularly with the Epipaleolithic (Fig. 23).

The anthropogenic imprint is very strong on all the faunal assemblages. However, this fact does not guarantee that absolutely every small animal in an assemblage was brought there by humans. The open rocky slope above the cave may well have provided roosts for certain shore birds and raptors, and thus, it is possible that these large birds introduced some non-cultural material (e.g., fish and shearwater bones) to the middens. On the other hand, fish (large breams of the genera *Sparus* and *Pagrus*) and bird remains (which include partridge) in the cultural layers were burned about as often as the bones of other vertebrates. The fish species are among the most important food fish species in other Mediterranean sites (e.g., Rose, 1995). Thus, these remains cannot be discounted as prey at this stage in the investigation.

A final note concerns the accumulation rates of ornaments relative to the remains of vertebrates, edible shellfish, and land snails in the cultural deposits (Table 11). Of the three categories of mollusks, only the ornaments show a strong positive correlation to the accumulation of vertebrate remains. This probably reflects the fact that ornaments and vertebrate remains were produced and deposited at relatively constant rates throughout the occupation of Üçağızlı, whereas shellfish may have represented a supplementary protein source when meat was in low supply (Epipaleolithic) or the littoral was particularly close (IUP layer I). Land snail abundance is also correlated with edible marine shellfish, but there is no evidence for their having been exploited as food. Thus, the link between land snail abundance and edible marine shellfish may have been an increase in ambient moisture whenever sea level was high.

Human remains

As with other early Upper Paleolithic sites in the Levant, human fossils are very sparse and fragmentary at Üçağızlı Cave. Through 2006, a total of ten isolated human teeth had been recovered from the site, a single specimen was also found during Minzoni-Deroche's earlier excavation. The human dental finds span the entire sequence from layer H through layer B. The dental remains consist for the most part of healthy adult teeth in varying states of wear. Overall, the morphology of the Üçağızlı human teeth is consistent with an attribution to *Homo sapiens*, but at least one possesses features more commonly associated with Neandertals (Güleç et al., 2007). More intensive comparative study of the human dental remains is underway.

Discussion

A central goal of research at Üçağızlı Cave was to better understand the character, age, and possible origins of the Initial Upper Paleolithic, one of the earliest, if not the first, clearly Upper Paleolithic behavioral complex outside of the African continent. Few of the Levantine early Upper Paleolithic sites excavated in the last 50 years afford good organic preservation alongside abundant stone tool industries in an unambiguous stratigraphic sequence. Of those that do preserve bone, comparatively few zooarchaeological data are currently available. The earliest human occupations at Üçağızlı Cave, represented by layers F through I, are nearly unique in this respect. A second motivation for the fieldwork was to clarify the nature of the transition from IUP to Ahmarian, whether it was gradual or abrupt and how it may have related (or not) to changes in local environments or demography. In this section we review the chrono-stratigraphic placement of the Üçağızlı sequence, and then address the transition between IUP and Ahmarian and the nature of the IUP more generally.

The Initial Upper Paleolithic component in Üçağızlı Cave closely resembles industries from the Lebanese sites of Ksar 'Akil, Abu Halka (Azoury, 1986; Ohnuma, 1988), and Antelias (Copeland, 1970). The similarities between the Üçağızlı sample and layers XXII–XXI of Ksar 'Akil (late Phase I) are particularly striking. Chanfreins are not very abundant in the IUP at Üçağızlı Cave, consistent with the idea that these assemblages correspond with the end of Phase I in Ksar 'Akil. Alternatively, the distribution of chanfreins may be regionally (or functionally) restricted. We note that Azoury (1986) reports many more unmodified Levallois flakes, points, and blades at Ksar 'Akil than were recognized at Üçağızlı Cave. This probably reflects different criteria for identifying Levallois end products. In fact, technological indicators such as the frequencies of faceted platforms at the two sites correspond more closely than would be suggested by the counts of Levallois flakes and points. There are other subtle points of resemblance between the earliest Upper Paleolithic layers at the two sites, including the predominance of burins on obliques.

The Ahmarian components of the Üçağızlı sequence (layers B through C) also present similar technological and typological profiles to the early Ahmarian assemblages from northern Levantine sites such as Ksar 'Akil layers XVI–XVII (Azoury, 1986; Bergman and Ohnuma, 1987; Ohnuma, 1988; Ohnuma and Bergman, 1990), Antelias shelter (Copeland, 1970; Copeland and Hours, 1971), and perhaps Yabrud Shelter II (Rust, 1950). Similarities among the Ahmarian industries from these sites can be observed in both the technology of blade production and in the artifact forms; particularly important are the scarcity of burins and relatively large numbers of pointed blades. Figure 24 shows just how closely the Üçağızlı sequence corresponds to the trend in layers XXII to XVI at Ksar 'Akil with respect to technological and typological indicators.

We note that some investigators refer to layers XXIII–XX at Ksar 'Akil as early Ahmarian rather than "transitional" or IUP. Although there is evidence that core technology in those levels differs from that of the earliest IUP in the Ksar 'Akil sequence (layers XXIV and XXV; Ohnuma and Bergman, 1990), it does not show the shift to soft-hammer percussion and classic prismatic blade cores that characterizes the classic Ahmarian. The blades in Ksar 'Akil layers XXIV–XXV may have been produced by a predominantly non-Levallois technique, but platform faceting and hard hammer percussion techniques were still used. For this reason we believe these assemblages more closely resemble the IUP than the classic Ahmarian from layers XVI and XVII.

Üçağızlı has yielded one of the largest series of radiocarbon determinations for the Upper Paleolithic in the eastern Mediterranean basin: only the Upper Paleolithic layers in Kebara Cave provide a comparable sample of dates (Bar-Yosef et al., 1996). The age estimates for Üçağızlı Cave fit well with much previous data on ages of early Upper Paleolithic complexes in the region, but diverge from some expectations.

The dates for layers B through C at Üçağızlı Cave fall within an interval of roughly of 29,000–34,000 radiocarbon years BP. This interval corresponds with the earlier end of the time range reported for early Ahmarian components at open air sites in the Sinai and Negev deserts of the southern Levant (Marks, 1983; Phillips, 1994; Bar-Yosef and Pilbeam, 2000) and for layer 11 at Qafzeh Cave (Bar-Yosef and Belfer-Cohen, 2004). The dates from the Ahmarian layers at Üçağızlı are considerably younger than the projected ages for Ahmarian layers XVI–XVII at Ksar 'Akil (Mellars and Tixier, 1989). However, the age projections for Ksar 'Akil are based on assumptions of constant deposition, so discrepancies could be due to changes in rates of sediment accumulation within that long sequence.

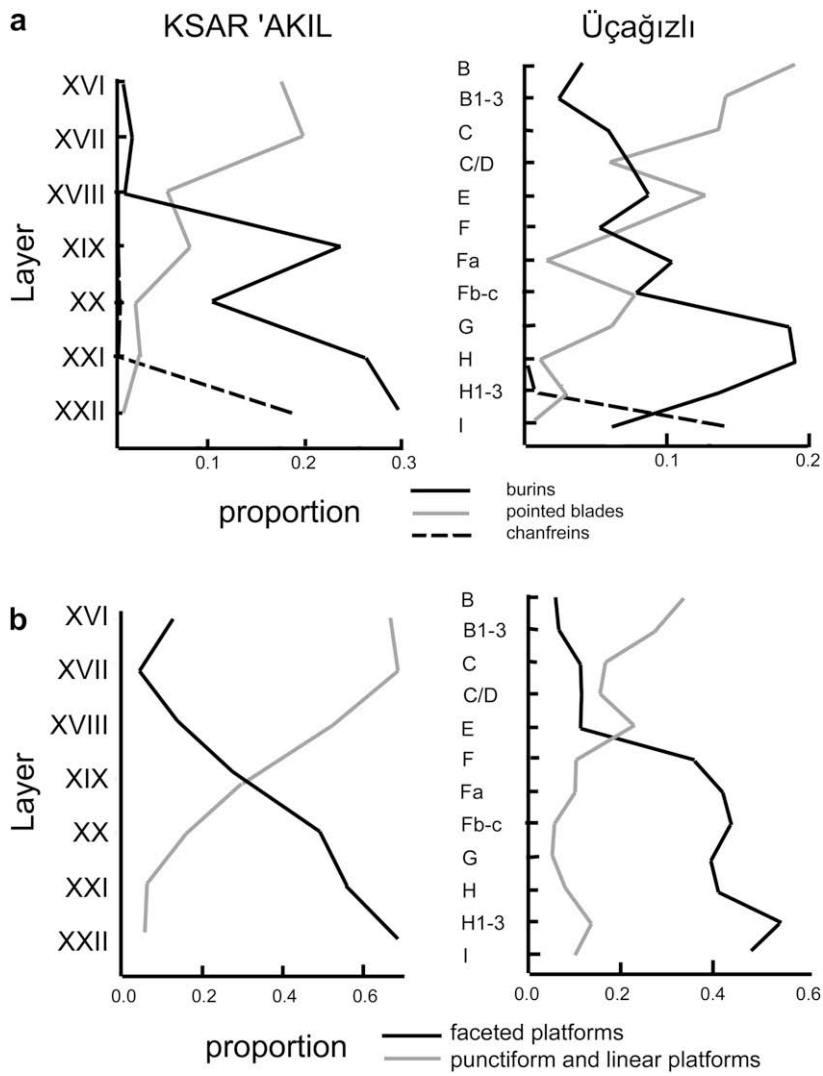

Fig. 24. Comparison of technological and typological indicators between the early Upper Paleolithic series from Üçağızlı Cave and Ksar 'Akil XVI–XXII: (a) frequencies of burins, chanfreins, and pointed blades; (b) frequencies of faceted and punctiform/linear platforms.

At first glance, the ^{14}C dates for the IUP at Üçağızlı appear more recent than estimates from other sites had led researchers to expect (e.g., Bar-Yosef, 2000; Bar-Yosef and Pilbeam, 2000). Radiocarbon dates of between 45,000 and 47,000 radiocarbon years BP, with very large sigma values, have been reported for Boker Tachtit, Level 1 (Marks, 1977, 1983) and projections from dated layers much higher in the sequence at Ksar 'Akil (Mellars and Tixier, 1989) have led to the proposition that the IUP at that site began about 50,000 radiocarbon years before present. In fact, because the uncertainties for the early determinations are so large, the two-sigma ranges for earliest IUP dates from Boker Tachtit, level 1 overlap with those of the earliest age determinations from Üçağızlı Cave. While this does not mean the ages are the same, it does indicate a non-trivial probability that they are equivalent. Moreover, if the Üçağızlı sequence indeed corresponds with levels XXII–XVI at Ksar 'Akil, then it would represent the later part of the IUP: there are three additional IUP layers below layer XXII at Ksar 'Akil. As such, there may be no real inconsistencies with age projections by Mellars and Tixier (1989).

It should be noted that not all Levantine early Upper Paleolithic assemblages with Levallois features yield maximum dates of $\geq$ 40,000 years. The *Paleolithique intermediare* of layer III2a' at Umm el Tlel in northern Syria (Bourguignon, 1998; Ploux and Soriano, 2003), which resembles the IUP of Üçağızlı layers F and Fa-c in many respects, has provided radiocarbon age estimates of between 36,000 and 34,500 uncalibrated years BP. A single determination of about 35,000 radiocarbon years BP was also obtained from the uppermost level (Level IV) at Boker Tachtit (Marks, 1983). Because all radiocarbon dates in this time range are minimum age estimates at best, at least part of the variation in ages of various layers yielding IUP and *Paleolithique intermediare* may be more apparent than real. However, the ^{14}C results also point to the possibility that IUP and similar assemblages were produced in the region for a long time. Hopefully, widespread application of high-precision ^{14}C sample preparation techniques and alternative dating methods such as TL and U-series will resolve questions about the age and duration of this earliest phase of the Upper Paleolithic in the Levant.

The absence of a distinct Aurignacian component from Üçağızlı Cave may also be explained by the ages of the deposits. In the southern Levant, dates from Kebara (Bar-Yosef et al., 1996) and Raqefet (Lengyel et al., 2006) caves place the Levantine Aurignacian in the range of 30,000–32,000 radiocarbon years ago, possibly earlier. If these age estimates are valid, then the Aurignacian may have been partially contemporaneous with the Ahmarian within the larger region. However, in the northern Levant, the Aurignacian of Ksar 'Akil overlies the Ahmarian stratigraphically (Ohnuma and Bergman, 1990). Radiocarbon ages for the only well-dated Aurignacian assemblage in Turkey—layer 22 in Karain B, near

Antalya—are 27,980 (± 240) and 18,960 (± 180; Yalçinkaya and Otte, 2000). This is more recent than the Ahmarian dates from layers B-B3 at Üçağızlı Cave. Thus, if an Aurignacian component once existed at Üçağızlı Cave, it may have been lost to erosion following the cave's collapse.

The Ksar 'Akil sequence is widely interpreted as showing a gradual, in situ transition from the IUP to the Ahmarian. However, the lower layers in Ksar 'Akil were excavated more than five decades ago, using thick stratigraphic units and large (4 m^2) horizontal excavation blocks. Thus, there was always the possibility that the appearance of gradual change was due to mixing of materials from adjacent layers. The picture from Üçağızlı Cave supports and reinforces conclusions drawn based on the record from Ksar 'Akil in showing largely gradual changes in lithic assemblages over time. It is noteworthy that the different elements of technology in the Üçağızlı sequence changed at different rates (Kuhn, 2004b), something that was not reported for Ksar 'Akil. Shifts in techniques of blade production were abrupt. Hard-hammer percussion gave way rather suddenly to soft hammer or indirect percussion in blade manufacture around the end of the IUP—the boundary between layers E and F. There may be a gap in sedimentation at this interval, but there is a good deal of continuity in other technological indicators. Characteristics such as blank selection and the proportions of different tool forms seem to have changed by small increments through the sequence. The shift from cores with single platforms to cores with two opposed platforms was also fairly abrupt, but occurred somewhat later in the sequence, between layers C and B1–3 (Kuhn, 2004b). Other aspects of material culture, most notably ornaments, also show a gradual transition from the IUP to Ahmarian.

From the current evidence it does not appear that the shift from IUP to Ahmarian at Üçağızlı Cave was tightly linked to general trends in foraging or environmental characteristics. The end of the IUP between layers F and E corresponds with the replacement of *Capra*-dominated faunas with cervid-dominated faunas, but goats become more important again toward the end of the sequence (Fig. 20). Like the situation observed for the stone tools, the different varieties of small game show a pattern of asynchronous change within the early Upper Paleolithic sequence. Shellfish were exploited for food mainly in the Ahmarian (and Epipaleolithic), but also were eaten during the earliest IUP (layer I). More directional trends include the gradual and rather subtle increase in the contribution of small animals of all sorts to the meat diet from layer I through B, and the decrease in the mean body size of ungulate prey.

Several lines of evidence do indicate that the duration of occupations and/or the sizes of groups occupying Üçağızlı Cave increased with time. Early in the sequence (IUP layers H-I), thin, discrete thermal features and aspects of lithic raw material exploitation (Kuhn, 2004a) suggest high residential mobility and comparatively brief stays at the site. Occupations at the later end of the sequence (Ahmarian layers B, B1–3) seem to have been larger in scale, more prolonged, or both, such that a thick midden of ash and garbage accumulated in the back of the cave. The increasing importance of small game to the total meat diet is also consistent with more intensive occupations, since larger-scale human presence could result in temporary strains on the supply of large game. Roe deer, the smallest and fastest-reproducing of the ungulates in the Üçağızlı fauna, is also most abundant in the most recent levels, further evidence that reliance on smaller-bodied prey increased in association with the most prolonged or intensive occupations. However, until analogous data from other sites are forthcoming, we assume that these changes represent local responses rather than characterizing the IUP and Ahmarian of the northern Levant as a whole.

The rich early Upper Paleolithic record in Üçağızlı Cave raises questions about the gamut of human activities that took place there and the purpose(s) of those occupations. Site classifications, such as "residential camps," "hunting camps," or other special use sites, are unsuitable for Paleolithic caves and shelters because most definable stratigraphic units and artifact assemblages typically formed over decades, centuries, or millennia. Given the fluidity of land use patterns among recent foragers (Kelly, 1995; Binford, 2001), it is unlikely that shelter sites were always used the same way over such long intervals. Additionally, the fact that a large part of the site is missing makes it difficult to determine the full range of activities that took place there. Even so, the preserved deposits indicate that Üçağızlı Cave was a place in which a wide range of activities usually took place, particularly during the later phases of occupation. There are certain commonalities in occupations over the entire sequence, however.

The dominance of large game remains and endscrapers in the retouched tool inventories, along with the microwear results, indicates that hunting and intensive hide processing were central activities throughout the early Upper Paleolithic occupations. The physical advantages of the locality and the rich patchwork of habitats may have made seasonal hunting both rewarding and attractive. Whether the heavy bias towards large game hunting at this site was a purely local phenomenon, or represents a more generalized pattern for IUP and Ahmarian shelter occupations in the coastal hills is uncertain. The sample of faunal remains recovered from Kanal Cave, the only other documented early Upper Paleolithic site in the area of Üçağızlı I, is small and highly selected. The next closest sites of comparable age are Karain B, Umm et 'Tlel, and Ksar'Akil, all located several hundred kilometers away. The sites of Karain B and Umm et 'Tlel occur in very different eco-geographic settings (Boëda and Muhesen, 1993; Griggo, 1998), whereas the early faunas from Ksar' Akil are under-reported (but see Kersten, 1987 on the Epipaleolithic).

Another activity that stands out in the Üçağızlı sequence is the production and use of beads. Ornament manufacture was a ubiquitous activity throughout the early Upper Paleolithic sequence. Among recent forager societies, beads and, more importantly, beaded clothing, headgear, and "accessories," serve in part to inform people outside the wearer's immediate group about that individual's age, marital status, role in society, and/or other characteristics. Foragers may carry ornaments and display them in almost any situation where they are likely to encounter strangers. Although decorative gear may provide visual clues about identity, the singularly large collections of beads from Üçağızlı Cave seems to embody routine use and refurbishment of beaded ornaments and clothing over a long period of time. The great abundance of ornaments in this site need not imply that it represented a special symbolic place in the cultural landscape of early Upper Paleolithic groups. Located by the sea and close to a ready source of raw material, the cave was without question a convenient place to collect raw materials and make shell beads.

Although shell ornaments are present in substantial numbers throughout the Üçağızlı sequence, there is a gradual shift from nearly exclusive reliance on a single species to use of as many as 20 genera. This trend could reflect increasing variety or complexity of information transmitted via personal ornamentation. However, isolated beads tell only a small part of the story, and composite ornaments or decorated clothing may have been much more important and elaborate. In the absence of detailed information on marine habitat and sea level changes, moreover, we cannot rule out habitat change effects. Inter-regional comparisons testify to widely shared rules of the basic elements for the basic units of ornamentation, especially with respect to shape, color, size, and perceptions of rarity (Stiner, 2003; Vanhaeren and d'Errico, 2006). These apparently strict aesthetics concerning the smallest units of self-decoration begin in Eurasia with the IUP and continued through the Upper and Epipaleolithic. The great networks of forager populations who found use for them may have contributed incentives

for standardization and a basis for continuity beyond the boundaries of any given group. The fine units represented by "beads" are likely to have been among the most conservative components of this novel medium of visual communication, with rules of combination being more flexible and variable in time and space.

Because the Initial Upper Paleolithic of the Mediterranean Levant is the first post-Middle Paleolithic culture complex in the area closest to Africa, the characteristics of the IUP have direct bearing on general questions about the appearance of the Upper Paleolithic behavioral complex. Some authors refer to the IUP as a "transitional" assemblage. Referring to an industry or culture complex as "transitional" implies that it is relatively fleeting, unstable, and short lived. The term also anticipates something that is neither "fish nor fowl"—a mixture of traits from earlier and later complexes or an entity that is somehow unfinished. We have avoided the term because it does not fit the evidence as currently understood. Emerging evidence from Üçağızlı and other sites shows that the Initial Upper Paleolithic was not strictly "transitional" and certainly not short-lived. Based on the available dating information, it is possible that IUP assemblages were produced in one part of the Levant or another for several thousand (radiocarbon) years. The IUP is also more than a combination of traits from earlier and later complexes. It has its own unique typological and technological features, including two unique artifact types—Emireh points and chanfreins (Garrod, 1955; Marks, 1990; Bar-Yosef, 2000). The chanfreins at least also show restricted regional distributions. Moreover, sites such as Üçağızlı, Boker Tachit, Ksar Akil (Marks, 1983, 1990, 1992; Bergman and Ohnuma, 1987; Ohnuma and Bergman, 1990), Umm el'Tlel (Böeda, pers. comm.), and Tor Sadaf (Fox and Coinman, 2001) demonstrate that the IUP exhibits both internal technological variability and distinct temporal trends. Finally, evidence from Üçağızlı shows us that virtually all of the typical characteristics of the Upper Paleolithic sensu largo, including shaped bone tools, ornaments, and shifting patterns of small game exploitation, were already established in the later IUP. And Üçağızlı is not unique. At least one bone tool (Bergman, 1987) and many beads were also recovered from the earliest Upper Paleolithic at Ksar 'Akil (e.g., Kuhn et al., 2001). Unfortunately, we know less about other sites due to conditions of preservation (Boker Tachtit, Tor Sadaf) or vagaries of archaeological recovery in early excavations (Emireh, Kanal).

In these and other respects the Levantine IUP seems quite typically Upper Paleolithic. The main feature that makes it seem "transitional" or intermediate between Middle and Upper Paleolithic is the persistence of features of Levallois technology. Although they are significant, characteristics such as hard-hammer technique, platform faceting, and some aspects of core geometry can be considered highly generalized ancestral, "plesiomorphic" features. The Levallois method was extraordinarily widespread in the later Eurasian Middle Paleolithic as well as the African Middle Stone Age (MSA). Their Levallois-like features suggest that the Levantine IUP technologies had their origins in the Middle Paleolithic or MSA somewhere. However, they alone cannot tell us whether the Levantine IUP documents a local evolution of the Levantine Middle Paleolithic into a kind of Upper Paleolithic.

Many researchers assume that the IUP developed out of the later Levantine Mousterian (e.g., Marks, 1990, 1992; Gilead, 1991). Others (e.g., Tostevin, 2003) dispute this claim. Tostevin's detailed technological analyses indicate that the superficial similarities between the known assemblages actually disguise more profound disjunction, although he recognizes that better candidates for local antecedents to the IUP may yet be discovered and described (2003:64). Others argue that the source of the Levantine IUP may ultimately be northeastern Africa (Bar-Yosef, 2000: 141–142). The Üçağızlı sequence cannot cast light on the origins of the Initial Upper Paleolithic in the Levant. What it does confirm is that the IUP was a fully developed, persistent Upper Paleolithic culture complex with its own patterns of regional variability and internal evolutionary dynamics, and that it was ancestral to the later Upper Paleolithic Ahmarian.

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Supplementary data

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