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The Upper Paleolithic of Wādī al-Ḥasā, Jordan

Introduction

Archaeological surveys and excavations in Wādī al-Ḥasā during the 1980s and 1990s have established that al-Ḥasā has one of the richest records of intensive human use during the paleolithic. Of the 1605 documented archaeological sites in al-Ḥasā, 23% are paleolithic (Clark *et al.* 1988, 1992, 1994; Coinman *et al.* 1986; MacDonald 1988). Of these, 32% or 78 of the paleolithic sites are attributed to the Upper and Epipaleolithic, and 57 (75%) of these sites are within 4km of ancient Lake Hasa, which dominated the pleistocene landscape of the eastern Ḥasā basin (Olszewski and Coinman 1998) (FIG. 1). A series of pleistocene lakes, ponds, and marshes characterized al-Ḥasā drainage and served as seasonal or multi-seasonal oasis for a variety of prey animal groups, including *Equus, Bos, Gazella, and Sus,* each of which would have utilized slightly different micro-habitats and resources within al-Ḥasā lake and drainage system.

The Upper Paleolithic in al-Ḥasā is now documented by an extended chronology for Ahmarian sites that includes the transitional Middle Paleolithic and Early Ahmarian at Ṭūr Ṣadaf rockshelter (WHNBS 8), a late phase of the Early Ahmarian at Tha'lab al-Buḥayra (EHLPP2), and ending with the Late Ahmarian at 'Ayn al-Buḥayra (WHS 618) and Yutil al-Ḥasā (WHS 784) (FIG. 2). This paper presents recent research at three of these Upper Paleolithic sites in order to illustrate the general trends in prehistoric use of al-Ḥasā during the late Pleistocene, as well as to demonstrate technological continuity and change from the earliest Upper Paleolithic to the latest Upper Paleolithic. More detailed descriptions of these sites may be found in Coinman (2000a).

Paleoenvironments of al-Ḥasā

During the Late Pleistocene, a series of dynamic ecological contexts featuring lakes, ponds, seasonal playas, and marshes characterized the landscapes of Wādī al-Ḥasā. Remnant lacustrine marls, paludal sediments, and tufa formations attest to a string of fresh water ponds, lakes, and perennial springs in the eastern basin of the Ḥasā drainage. Lake Hasa may have covered some 50km^2 before it began to recede after ca. 20,000 bp (Schuldenrein and Clark 1994). The level of alkalinity of Lake Hasa is unknown, but relatively fresh spring water concentrations probably existed around the southwestern margins where the largest number of paleolithic sites have been located, while the far eastern margins of the lake (Qā' al-Jinz) east of the present-day Desert Highway were most likely characterized by much shallower, more alkaline playas, similar to what can still be found today in the Azraq basin (Byrd and Garrard 1990; Garrard *et al.* 1988). The exact nature of the climatic environments in the inland basins of the Levant (ʒ the Last Glacial Maximum (ca. 25-17,000 bp) is still unclear, but a growing body of evidence suggests that the high lake levels were recharged by high water tables and spring resurgence throughout the eastern Mediterranean during much of the late Pleistocene (Macumber and Head 1991; Benson and Thompson 1987, and others). Although limited pollen evidence suggests a relatively cold steppe environment with sage and short grasses (Clark *et al.* 1988), regionally high water tables argue for a wetter, although cool, environment capable of supporting such diverse species as *Equus hemionus/asinus, Equus hydruntinus, Equus caballus, Sus scrofa, Bos primigenius,* and *Gazella sp.* Since each of these species requires different grass and wooded habitats and because remains of all of these species have been found at sites in the eastern Ḥasā basin between 26,000 and 19,000 bp, we can infer that a complex mosaic of habitats existed during the Last Glacial Maximum within what is today a decidedly xeric hydrographic zone.

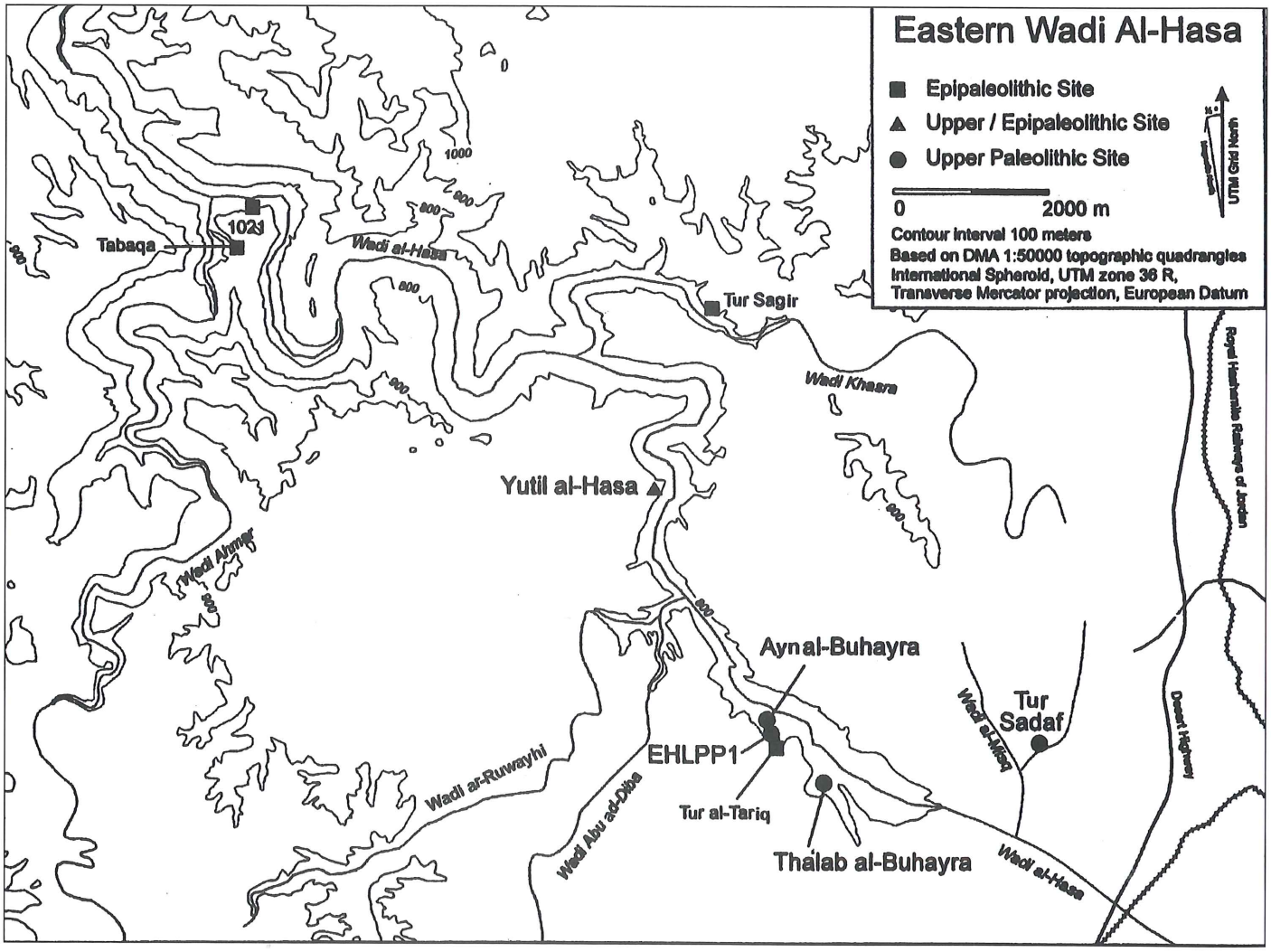
Lake and marsh ecological settings similar to those found in the Ḥasā characterized a number of areas of the Levant during the late Pleistocene. Lake/marsh habitats existed in southern Sinai (Phillips 1988; Gladfelter 1990, 1997), in the Azraq area of Jordan (Byrd and Garrard 1990), on both sides of the former Lake Lisan (Macumber and Head 1991), on the ancient shores of the Sea of Gal-

ilee (Kislev *et al.* 1992; Nadel and Hershkovitz 1991), in the Damascus Basin (Sakaguchi 1978; Julig *et al.* 1999), and in the Jafr Basin of southern Jordan (Huckriede and Wiesemann 1968). Upper Paleolithic sites in significant numbers have been found in association with this type of ecological context. With the exception of Gladfelter's study of Wādī Fīran (Gladfelter 1990, 1997), however, such geoarchaeological contexts have been greatly overlooked and understudied. Current research on the faunal remains recovered from lakeshore sites in al-Ḥasā suggests there is a wealth of information on late Pleistocene subsistence strategies that is well-preserved in such lacustrine geological sediments and which typically is missing or poorly preserved at open-air archaeological sites in most regions of the Levant during this time period.

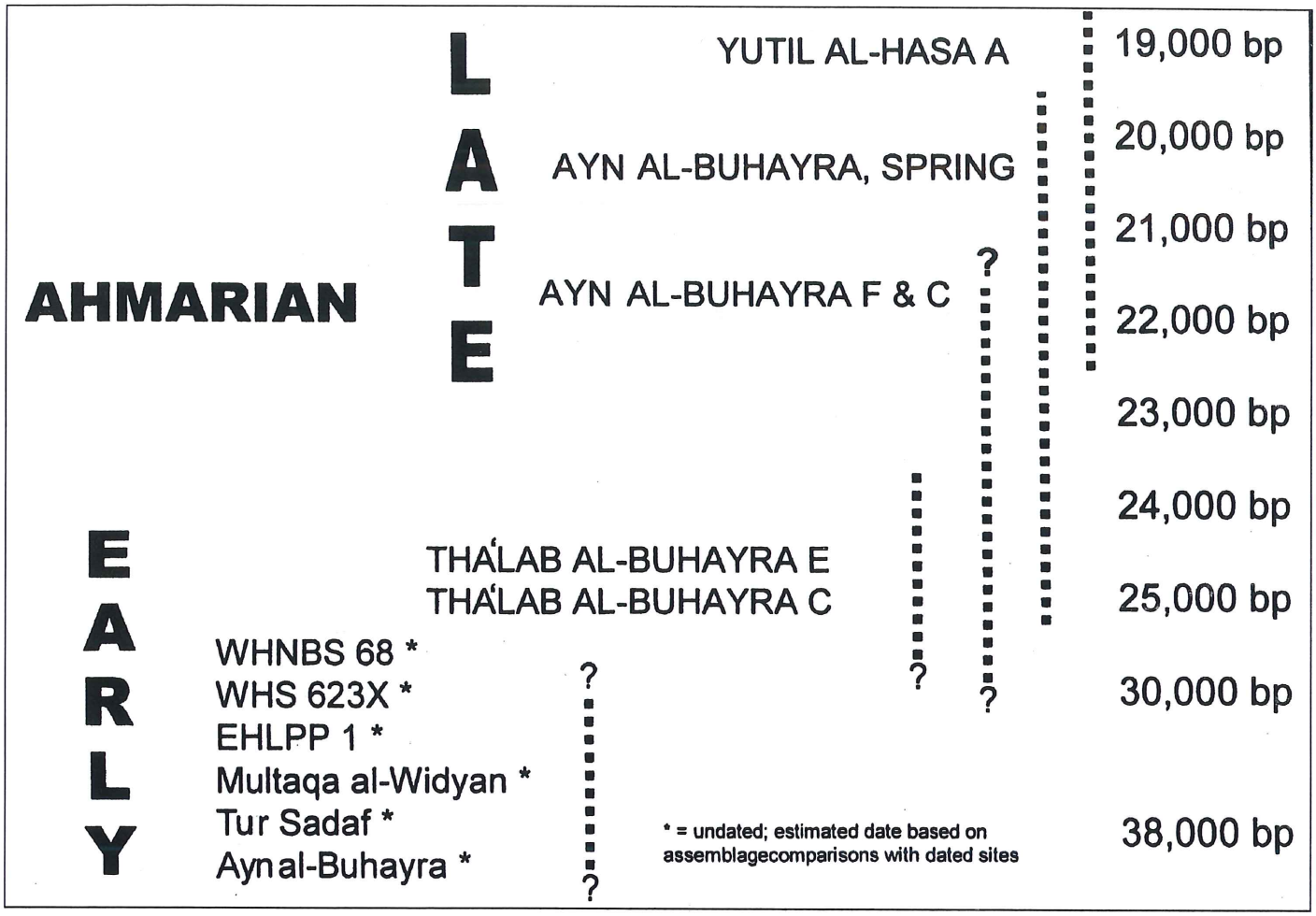
Ṭūr Ṣadaf Rockshelter

Ṭūr Ṣadaf is a shallow, east-facing rockshelter in a small secondary drainage leading southwest to Wādī al-Misq, which currently drains directly into Wādī al-Ḥasā (see FIG.1). Cultural sediments more than 1m in depth have been preserved under a shallow overhang comprised of a Cretaceous oystershell formation (FIG. 3). Preliminary evaluation of the faunal remains suggests they are limited to medium-sized mammals, such as gazelle, rather than the larger bovids and equids that dominated the later Upper Paleolithic sites around the margins of nearby Lake Hasa. The site has not been dated radiometrically because preserved charcoal remains are sparse in the areas excavated, and animal bone submitted for potential dating lacked sufficient preserved collagen. The lithic assemblages, however, are most similar to others dated to ca. 38,000 bp and older, suggesting that Ṭūr Ṣadaf may date to the earliest phase of the Upper Paleolithic in the Levant.

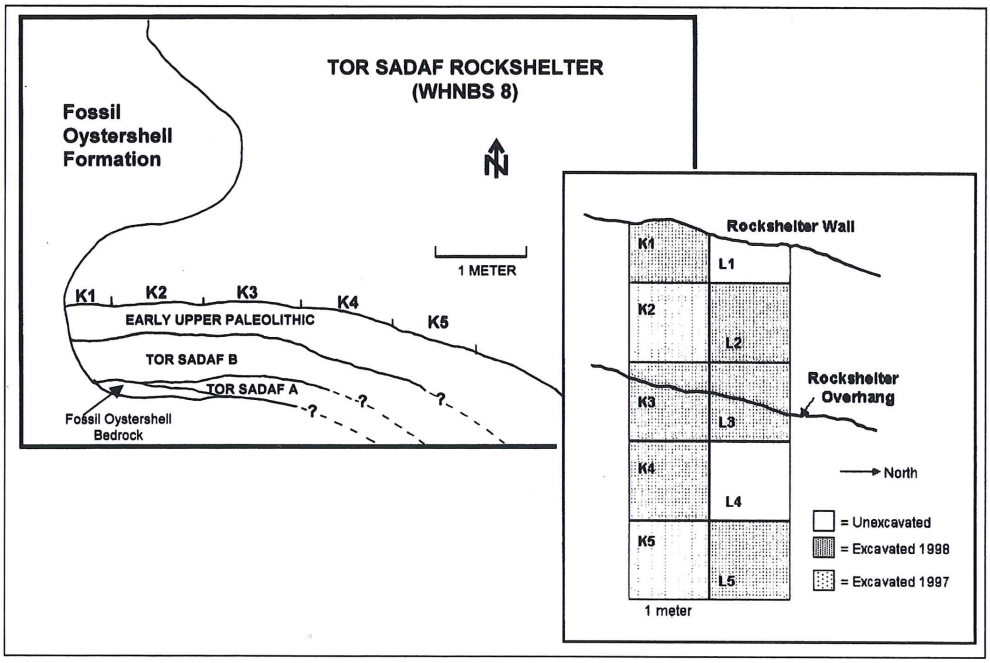
After initial testing in 1997 (Olszewski *et al.* 1998),



1. Map of the eastern end of Wādī al-Ḥasā, showing the locations of Upper Palaeolithic sites discussed in text.



2. Chronology of Upper Palaeolithic sites in Wādī al-Ḥasā.



3. Stratigraphic profile and excavation units at Ṭūr Ṣadaf rockshelter.

expanded excavations were conducted in 1998 revealing an *in situ* transition from a late Middle Paleolithic technology featuring Levallois techniques to the emergence of the earliest Upper Paleolithic Ahmarian technology (Coinman and Fox 2000; Fox 2000; Fox in press). The sequence at Ṭūr Ṣadaf is comparable to the well known transitional assemblages from Boker Tachtit in the Negev (Marks 1983) and Ksar Akil in Lebanon (Ohnuma and Bergman 1990). However, the sequence at Ṭūr Ṣadaf fills an important technological gap that is missing at Boker Tachtit and Ksar Akil by providing evidence for the intervening technological changes that illustrate a clear local Levantine evolution in reduction strategies from the late Mousterian to the earliest Ahmarian blade technology. It thus affords us one of the best opportunities to understand the nature and timing of the transition from the Middle Paleolithic to the emergence of an Early Upper Paleolithic technology and a suite of cultural characteristics that are viewed by many to be the correlates of modernity (e.g., Kuhn *et al.* 1999).

Lithic Assemblages

The lithic assemblages recovered from Ṭūr Ṣadaf are extensive and relatively dense throughout most of the levels in all eight excavated units. Units outside the rockshelter and downslope, representing primarily the latest occupation, are less dense with the uppermost levels in K4, K5, and L5 exhibiting significant impact from modern Bedouin activities and slope movement and erosion. Nonetheless, fairly well-defined trends in debitage and tool production can be identified. Although it was not possible to discern clear sedimentological demarcations between what might represent major cultural assemblages, the lithic assemblages from arbitrary excavation levels can be grouped into at least three successive occupation units representing a continuous sequence of steady, overlapping changes in the types of cores, debitage, core trimming elements, and tools. This was achieved by closely examining debitage frequencies in comparable arbitrary levels and identifying three analytical units which approximate the major technological trends occurring at the site. The correlation between these analytical units (occupations) and arbitrary excavation levels in each of the eight units can be found in Coinman and Fox (2000: Table 6.2).

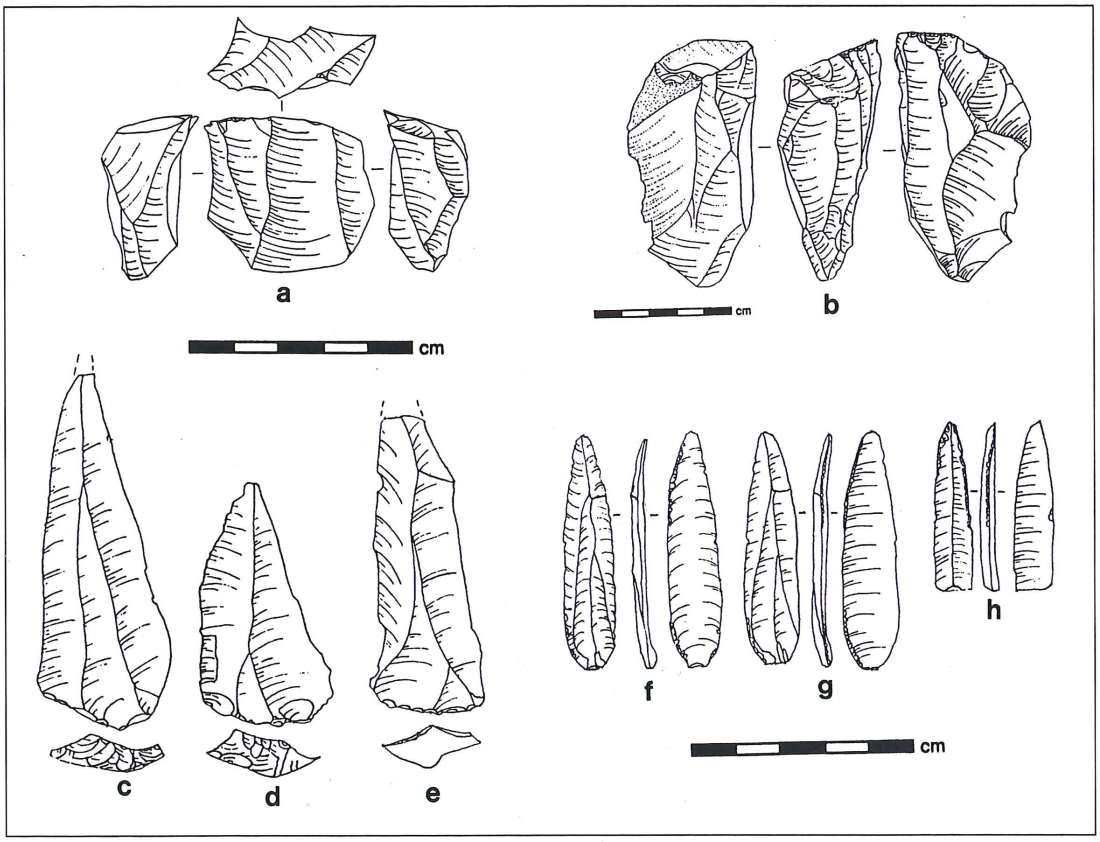
In the stratigraphic sequence a Levallois dominated technology in the lowermost Ṭūr Ṣadaf A levels evolves into a more clearly transitional stage in Ṭūr Ṣadaf B levels, culminating in a fully Upper Paleolithic Ahmarian blade and bladelet technology in the uppermost levels[1] (TABLE 1). The orientation and preparation of cores changes significantly from prepared cores with multi-faceted platforms in the lower levels to cores with unfaceted platforms in the upper levels (FIG. 4). In the earliest occupation (Ṭūr Ṣadaf A), 60% of the cores have multi-faceted (more than one facet), prepared platforms. This decreases to 37% during the middle levels (Ṭūr Ṣadaf B). In the Early Upper Paleolithic occupation, only 17% of the core platforms are prepared. Debitage production mirrors major shifts in core reduction strategies and illustrates a well-defined directional change through the three occupations. The most important trend is the increase in the production of progressively smaller bladelet debitage at the expense of larger blades. Flake production decreases as mean widths of blade and bladelet debitage decrease from earlier to later occupations (TABLE 2). Similarly, platform types and sizes change dramatically. Three platform types are present in all but the upper most levels – large multi-faceted Levallois platforms, large single-faceted platforms that include the unregularized, scalloped platforms, and very small, punctiform platforms.

The production of tools at Ṭūr Ṣadaf underwent a major transition that is clearly illustrated by a shift in production goals in which the most important tool types change. In virtually all levels at Ṭūr Ṣadaf, pointed tools dominate the tool kits (see TABLE 1). Scrapers make up the only other formal tool class of any significance. In the earliest levels, Levallois points – predominantly elongated Levallois blade points rather than flake points – give way to more Levallois-like points in Ṭūr Ṣadaf B levels where the blanks continue to exhibit typical Levallois converging Y-arrêt dorsal scars, but platforms are large, unfaceted, and they retain the unregularized edges of the cores from which they were removed (FIG. 4a). The change from Levallois points with multi-faceted platforms to those with large, unfaceted platforms in the lower occupation levels is gradual, but the replacement of Levallois point types by what are most certainly the hallmarks of the Levantine Upper Paleolithic – el-Wad points – is more dramatic (FIG. 4f-g). El-Wad points at Ṭūr Ṣadaf are typical of point varieties in Ahmarian industries throughout the Levant, including those found in the Lagaman assemblages of northern Sinai (Bar-Yosef and Phillips 1977; Gilead and Bar-Yosef 1993), at Boker A (Jones *et al.* 1983), at sites in southern Jordan (Coinman and Henry 1995; Kerry 1998; Williams 1997), as well as those recovered from Tha'lab al-Buḥayra, discussed below. These points are characterized by very small punctiform platforms and diffuse bulbs, and they are either naturally pointed or shaped into points by steep to fine graded retouch with inverse or obverse retouch on one or both edges, but predominantly on the right, obverse edges (Coinman 1999). The shift to smaller pointed implements

[1] In an earlier publication, the occupation levels were referred to as Transitional A, Transitional B and Early Upper Paleolithic (Coinman and Fox 2000: 128).

TABLE 1. Comparative Percentages for Selected Artifact Categories at Ṭūr Ṣadaf Rockshelter (WHNBS8).

	Tor Sadaf A		Tor Sadaf B		Early UP	
	n	%	n	%	n	%
Core Platforms						
Unfaceted	22	40.0	29	53.7	68	78.2
Dihedral	8	14.5	13	13.0	9	10.3
Multi-faceted	25	45.5		24.1	6	6.9
Other	0	0.0	5	9.3	4	4.6
Debitage						
Blades	468	13.2	489	11.3	758	6.7
Bladelets	207	5.9	308	7.1	2567	22.8
Tools						
Scrapers	19	15.7	34	17.5	45	13.4
Burins	1	0.8	6	3.1	9	2.7
Elongated Levallois Points	62	51.2	60	30.9	8	2.4
Levallois Flake Points	4	3.3	15	7.7	1	0.3
Retouched Blades	13	10.7	29	15.0	20	6.0
Retouched Bladelets	3	2.5	10	15.2	63	18.8
el-Wad Points	0	-	3	1.6	150	44.6



4. Artifacts from Ṭūr Ṣadaf rockshelter (WHNBS 8): a – core from Ṭūr Ṣadaf A levels; b – core from EUP (Early Ahmarian) levels; c, d - Levallois points from Ṭūr Ṣadaf A levels; e – Levallois-like point from Ṭūr Ṣadaf B; f-h - el-Wad points from EUP (Early Ahmarian) levels.

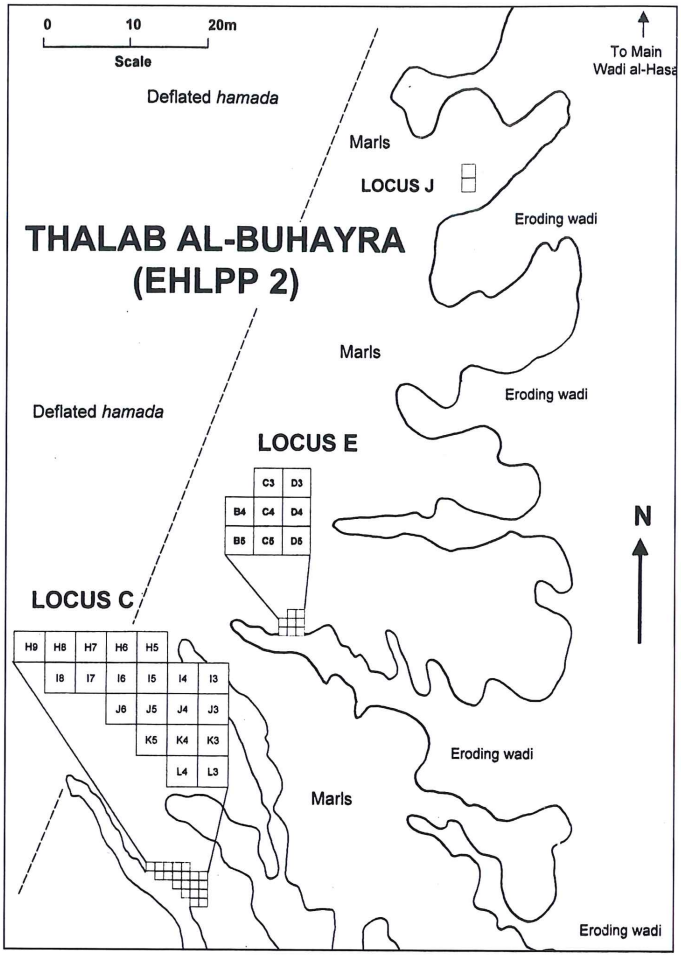
represents a significant change in core reduction strategies and blank production. The vectored change in point production throughout the levels at Ṭūr Ṣadaf is best illustrated in the changing metrics of points (see TABLE 2). With the emergence of el-Wad points in the Early Upper Paleolithic levels, elongation in point blanks, as measured by mean length:width ratios, jumps considerably from 2.7 to 5.5 (TABLE 2).

The directional changes in lithic technology at Ṭūr Ṣadaf provide very strong support for the notion that the Early Ahmarian industry, which is common throughout the Levant, developed directly from a transitional industry or what Marks (1983, 1993) and others (e.g. Ohnuma and Bergman 1990; Kuhn *et al.* 1999) prefer to call the "Initial Upper Paleolithic" industry. The occupation sequence at Ṭūr Ṣadaf may represent one of the only known sites where an Early Ahmarian assemblage is found stratigraphically overlying materials of a transitional nature.

Tha'lab al-Buḥayra (EHLPP2)

The site of Tha'lab al-Buḥayra (EHLPP2) is a very large open-air site that is situated where the modern ḥamada (deflated desert pavement) intersects remnant lacustrine marls, representing a series of ancient shorelines of Pleistocene Lake Hasa. The site was initially tested in 1998 and excavated more intensively in 2000 (Coinman *et al.* 1999, Coinman 2000a, 2000b; Olszewski *et al.* 2001) (FIG. 5). On-going erosion of the marls has resulted in the exposure of a sequence of distinct buried cultural strata characterized by faunal remains and lithic artifacts. Three areas of the site are separated spatially and appear to represent *at least* three, possibly four, different occupations. A series of ancient shorelines are indicated by the position and slope of buried cultural assemblages and features (e.g., hearths) near the intersection of the marls and the ḥamada.

Three areas of the site have been investigated and broad exposures carried out at two of these areas. Locus J consists of a knapping area in the northern sector of the site where a single core and associated debitage were recovered in the upper 25cm of eroding sediments. At Locus E, eight square meters have been excavated revealing a cultural zone between 10 and 50cm below the surface with remnant hearths, clusters of equid teeth, and very



5. Map of Tha'lab al-Buḥayra (EHLPP2) showing the location of excavation units.

dense lithics. At Locus C, eighteen square meters have been excavated, uncovering remnants of numerous hearths or areas where burning occurred, evidence of extensive primary lithic reduction, and animal butchering and processing. The majority of the cultural material is isolated stratigraphically below relatively sterile, loose marl sediments in extremely consolidated fine marls between 30 and 80cm below the modern surface. Within this zone of cultural deposits, more specific microstratigraphic units associated with specific occupation episodes have been difficult to discern.

TABLE 2. Metric Dimensions of Selected Attributes on Debitage and Tools from Ṭūr Ṣadaf Rockshelter (WHNBS8).

	Bld/Bldt Width			Bld/Bldt L:W Ratio			Bld/Bldt Platform Size (WxTh)			Levallois-like Points Width			el-Wad Points Width			Point L:W Ratio		
	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
EUP	435	12.2	5.7	435	4.1	1.2	709	9.6	2.8	-			152	7.0	1.5	20	5.5	1.1
Tor Sadaf B	164	20.5	7.3	164	2.9	0.9	284	83.3	77.1	54	22.3	5.1	-			54	2.7	0.7
Tor Sadaf A	160	20.6	7.4	160	3.0	0.8	225	98.3	85.2	48	22.9	6.2	-			48	2.7	0.8

Both Locus C and Locus E have produced AMS radiocarbon dates between ca. 26,000 and 24,000 bp (TABLE 3). The lowest cultural material at Locus C has been dated to 26,010 ±130 bp (Beta 153156) and may represent a discrete early occupation episode, but the deposits are quite limited in extent. Above this, the main cultural zone at Locus C produced two dates: 25,680 ±100 bp (Beta 129818) and 25,660 ±120 bp (Beta 153157) from bulk sediments containing high concentrations of charcoal from remnants of informal hearths. In contrast, more formal hearths at Locus E have produced two slightly younger dates: 24,900 ±130 bp (Beta 129817) and 24,280 ±190 bp (Beta 153155). The zone of cultural deposits at Locus E is stratigraphically higher than that at Locus C, occurring in the upper, loose marl sediments. In addition to stratigraphic and temporal differences, the artifact assemblages at Locus E exhibit differences that may be attributed to different activities occurring slightly later and in a different area of the site.

Intra-Site Comparisons

The tool kits at the two main areas of Tha'lab al-Buḥayra exhibit strong similarities in the types of tools that were produced, used, and discarded, but the proportions of different tools somewhat vary (TABLE 4). Scrapers were manufactured on a variety of different sized flakes and blades and were made on both cortical and non-cortical blanks. Scrapers were the predominant tool type recovered at Locus C (42.9%), while only 25.8% of the retouched pieces recovered from Locus E were scrapers (FIG. 6). Micro-serrated edges on some scrapers are typical of what are known as 'Ksar Akil' scrapers (FIG. 6a, h) (Copeland 1982; Besançon *et al.* 1975-77:37; Jones *et al.* 1983: 310-311), while some endscrapers have serrated edges (FIG. 6b, i).

Both areas exhibit similar proportions of truncated tools with approximately 20% of the tools made into truncations (FIG. 6c-g). Truncated tools exhibit a greater degree of standardization than scrapers and were made exclusively on interior, non-cortical blades or bladelets, which often feature truncations at both ends (FIG. 6e, g). Mean widths are essentially the same for truncated pieces at both areas: 12.4mm at Locus C (n=51) and 12.8mm at Locus E (n=74). A majority of the lateral edges of the truncations from both areas was utilized. Alteration of the edges due to damage from use and/or deliberate retouch characterizes 68.6% of the truncations at Locus C and 51.4% of the edges at Locus E, suggesting that the blade edges as well as the truncated ends were functionally important aspects of these tools.

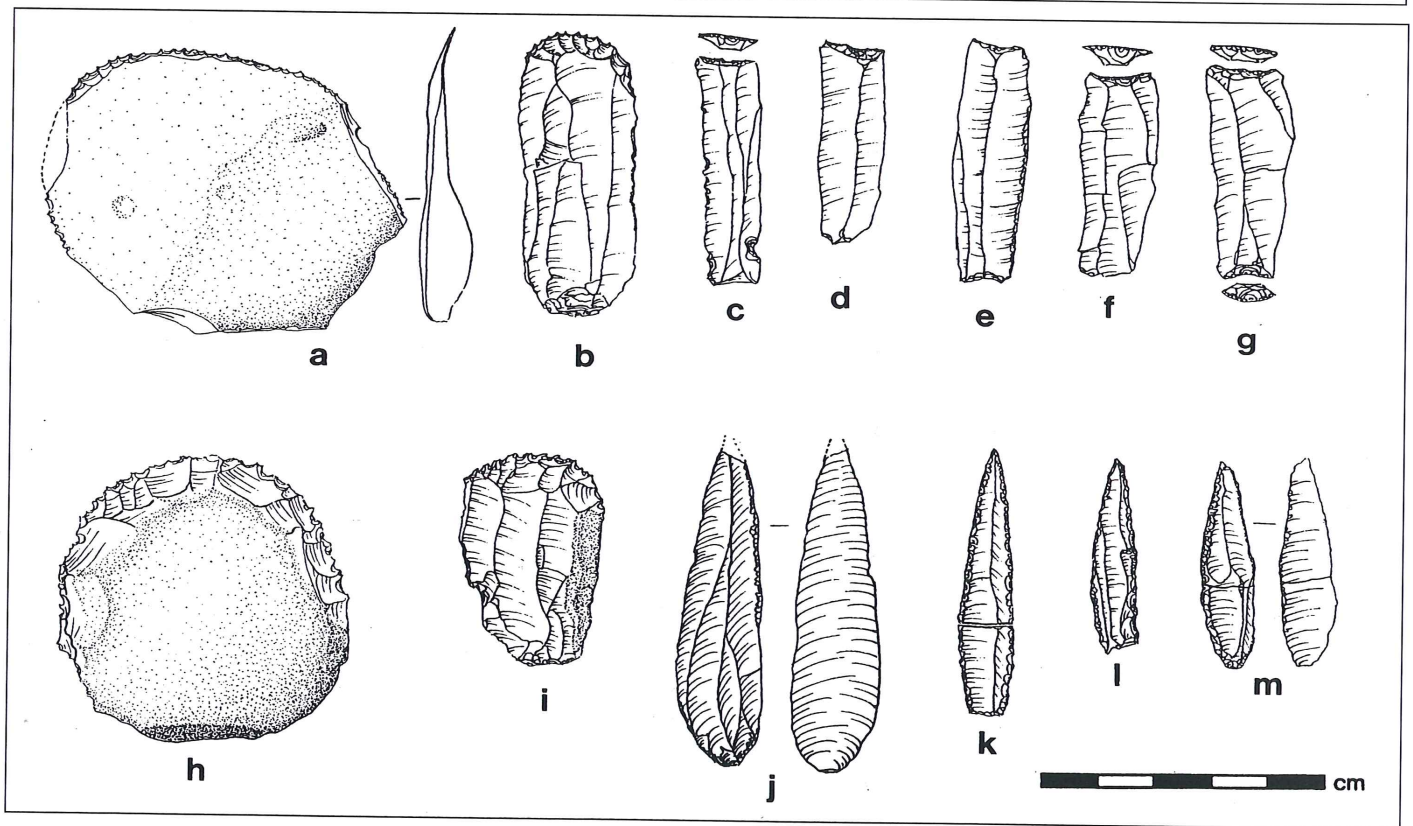
TABLE 3. Radiocarbon Dates from Upper Paleolithic Sites in Wādī al-Ḥasā.

Site	Radiocarbon Date (bp)	Context	Material	Lab No.
Ain al-Buhayra (WHS 618 Spring)	20,300±600	Test I, L2 hearth	charcoal in tufa/marl sediments	UA-4395
Ain al-Buhayra (WHS 618 Spring)	20,670±600	E68,N42, L.6 hearth	charcoal in tufa/marl sediments	Beta-118757
Ain al-Buhayra (WHS 618 Spring)	23,500±270	South Profile ~0.15 m below surface; probable hearth	charcoal in tufa/marl sediments	Beta-56424
Ain al-Buhayra (WHS 618 Spring)	18,960±580*	South Profile ~0.6 m below surface	soil sediment ir tufa/marl deposits	Beta-55933
Ain al-Buhayra (WHS 618 Area F)	25,950±440	~0.2-0.3 m below surface	organic sediment	Beta-55928
Thalab al-Buhayra (EHLPP2 E)	24,280±190	Locus E, Unit C3, Level 3 hearth	charcoal in soil sediments	Beta-153155
Thalab al-Buhayra (EHLPP2 E)	24,900±130	Locus E, Unit B5, Level 5 hearth	charcoal in soil sediments	Beta-129817
Thalab al-Buhayra (EHLPP2 C)	25,660±120	Locus C, Unit I3, Level 10 ?hearth	charcoal in soil sediments	Beta-153157
Thalab al-Buhayra (EHLPP2 C)	25,680±100	Locus C, Unit K3, Level 3**	charcoal in soil sediments	Beta-129818
Thalab al-Buhayra (EHLPP2 C)	26,010±130	Locus C, Unit I3, Level 11 ?hearth	charcoal in soil sediments	Beta-153156

*Date appears to be anomalous as it occurs stratigraphically within older dated contexts.
**Level 3 (1998) is the same as Level 7 (2000), the main cultural deposits representing occupation at Locus C.

TABLE 4. Comparative Percentages for Selected Categories of Lithics at Tha'lab al-Buḥayra (EHLPP2).

Thalab al-Buhayra (EHLPP2)	**Locus n**	**C %**	**Locus n**	**E %**
Debitage	6045		12281	
Cores	86	1.4	49	.4
Flakes	1925	31.8	3280	26.7
Blades	844	14.0	1299	10.6
Bladelets	768	12.7	2354	19.2
Primary Elements*	608	10.0	642	5.2
Retouched Pieces	247		356	
Scrapers	106	42.9	92	25.8
Truncations	51	20.6	74	20.8
Ret. Blades	19	7.7	59	16.6
Ret. Bladelets	25	10.1	42	11.8
el-Wad Points & fragments	31	12.5	49	13.8
* >50% cortex				



6. Artifacts from Tha'lab al-Buḥayra (EHLPP2): a, h - Ksar Akil scrapers; b, i – mircro-serrated endscrapers; c, d, f – truncations; e, g – double truncations; j-m – el-Wad points.

Initially, it was thought that the tool kits from both areas of the site were relatively specialized and focused on expedient tool manufacture for scraping (i.e., scrapers and truncations), but a closer look at the retouched assemblage reveals a higher proportion of the retouched blades and bladelets may be fragments of pointed imple-

ments. Although more than twice as many retouched blades are represented at Locus E, at both areas, similar proportions of the retouched pieces represent pointed implements, such as el-Wad points (FIG. 6j-m). This category includes complete points with deliberate steep retouch along one side or portions of both sides, particularly the distal ends, as well as fragments that exhibit similar continuous and consistent steep retouch along the edges of proximal, medial or distal fragments. Micro-wear studies on el-Wad points are limited, but Williams (1997) has provided convincing evidence that el-Wad points from the Early Ahmarian sites in south Jordan were used as projectiles, while some retained evidence of multiple uses, such as perforators with circular wear around the distal tips and as cutting tools. A number of truncations from Tha'lab al-Buḥayra appear to be recycled points with steep retouch along lateral edges and distal and/or proximal ends that were subsequently truncated. Thus, the discarded tools at both loci at Tha'lab al-Buḥayra along the ancient shorelines of Lake Hasa may have been rather narrowly focused on a limited number of activities associated with processing animal carcasses and skins, and more indirectly with the hunting or procurement of such animals with pointed implements.

Comparative analyses of artifact distributions at Locus C and Locus E suggest specific activities may be reflected in the spatial patterning and co-occurring artifacts, faunal remains, and remnant hearths. Differences in the lithic assemblages, including metric sizes and proportions, also suggest that some activities varied or were differentially emphasized during the occupations represented at these two areas of the site (TABLE 4). Relative proportions of cores and primary reduction elements (> 50% cortex) are nearly twice as frequent at Locus C than at Locus E, suggesting more on-site primary reduction occurred during the occupation at Locus C. A comparison of the densities of lithics in comparable volumes of excavated cultural deposits indicates an average of 390 lithics per $1m^2$ at Locus C compared to 1791 lithics per $1m^2$ at Locus E. Detailed attribute analysis of a large sample of debitage from both areas also suggests that different segments of the reduction sequence were emphasized at Locus C and that some spatial concentrations in both areas of the site show significantly more primary reduction than others.

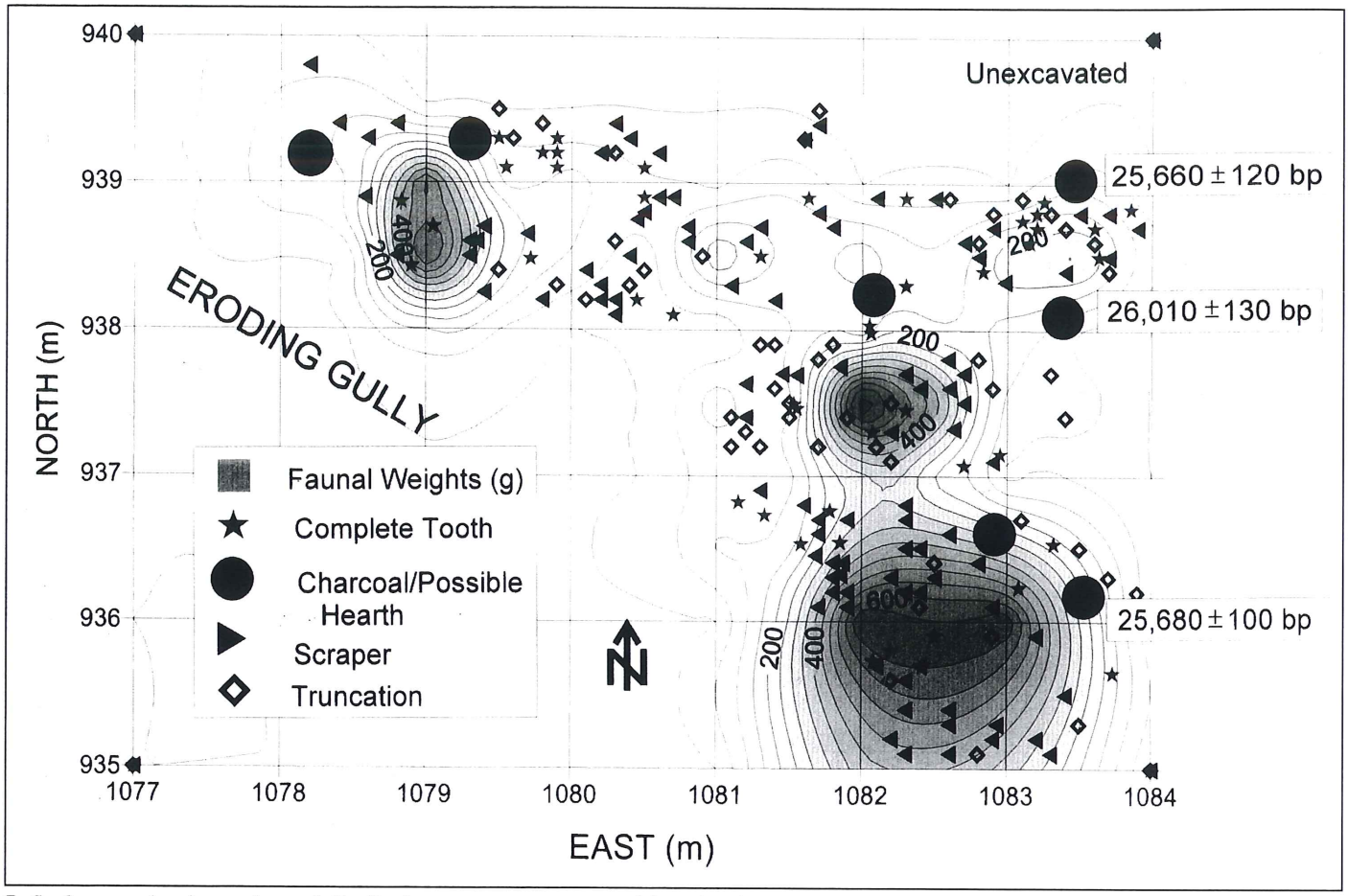
The *Surfer* mapping program provides a means of illustrating spatial distributions as contours or as specific artifact point proveniences. Although all units in both areas were excavated in 5cm arbitrary levels, finer-grained stratigraphic and behavioral units that might potentially represent a series of activity *episodes* have been difficult to sort out from the dense distributions of artifacts, faunal remains, charcoal, fire-cracked rock, ubiquitous residues of red and yellow ochres, and other soil stains. Therefore, *Surfer* density maps represent artifact categories within an approximate 30-50cm "cultural occupation zone" that has been collapsed for the purpose of getting an initial impression of contextual relationships, spatial distributions, and areas with exceptionally high densities. Only Locus C is presented here as a preliminary attempt at defining activity areas since Locus E represents a much smaller exposure, and the different scales of spatial distributions may not be comparable.

A contoured density map of the weights of faunal remains (bone) in FIG. 7 shows three relatively discrete areas where animal remains were uncovered. The densest are in the southernmost units where approximately 700 grams of bone and bone fragments were retrieved. When complete teeth (predominantly equids) are mapped, a clear association with the concentrations of faunal remains is revealed. Numerous cranial and mandibular fragments were recovered, but the majority of faunal remains are fragments, where a high proportion have been identified as fragments of the appendicular skeleton (Thompson 2001: 92). The association of teeth and tooth fragments suggests processing activities in which fatty-rich animal tissue and marrow were extracted from crania and mandibles, as well as from limb elements, where fat is most abundant.

More intriguing, however, is the direct association of scrapers and truncations with the faunal remains. The fauna occur in essentially the same areas as high distributions of primary core reduction, making the associated scrapers and truncations the likely end products of expedient on-site core reduction and tool production for the immediate processing of a number of animal carcasses. Equids, a limited number of bovids and gazelle, a single wild boar, and a very large unidentified herbivore comprise the animals represented (Thompson 2001: 90). Use-wear studies have yet to be completed, but we might suggest that truncated blades would have been ideal tools for relatively precise scraping and cleaning of bone, while the larger flake and endscrapers would have been used to scrape and work animal skins. Throughout the areas excavated so far at Locus C, the soils are intensely stained and mottled with red and yellow ochres, minerals that may have been used in the processing of skins. More enigmatic, though, are the enormous numbers of angular local limestone rocks that occur consistently and exclusively with the cultural assemblages, some of which are clearly fire-affected or fire-cracked. The precise function of such introduced rocks is unclear, but their association with the faunal remains, the hearths, and the soil staining is indisputable.

'Ayn al-Buḥayra (WHS 618)

'Ayn al-Buḥayra is a very large, multi-component site about 1km to the northwest of Tha'lab al-Buḥayra and similarly sprawled along the ancient shoreline of Lake Hasa (Coinman 1990, 1993, 1997a,b,c; 1998; 2000, in

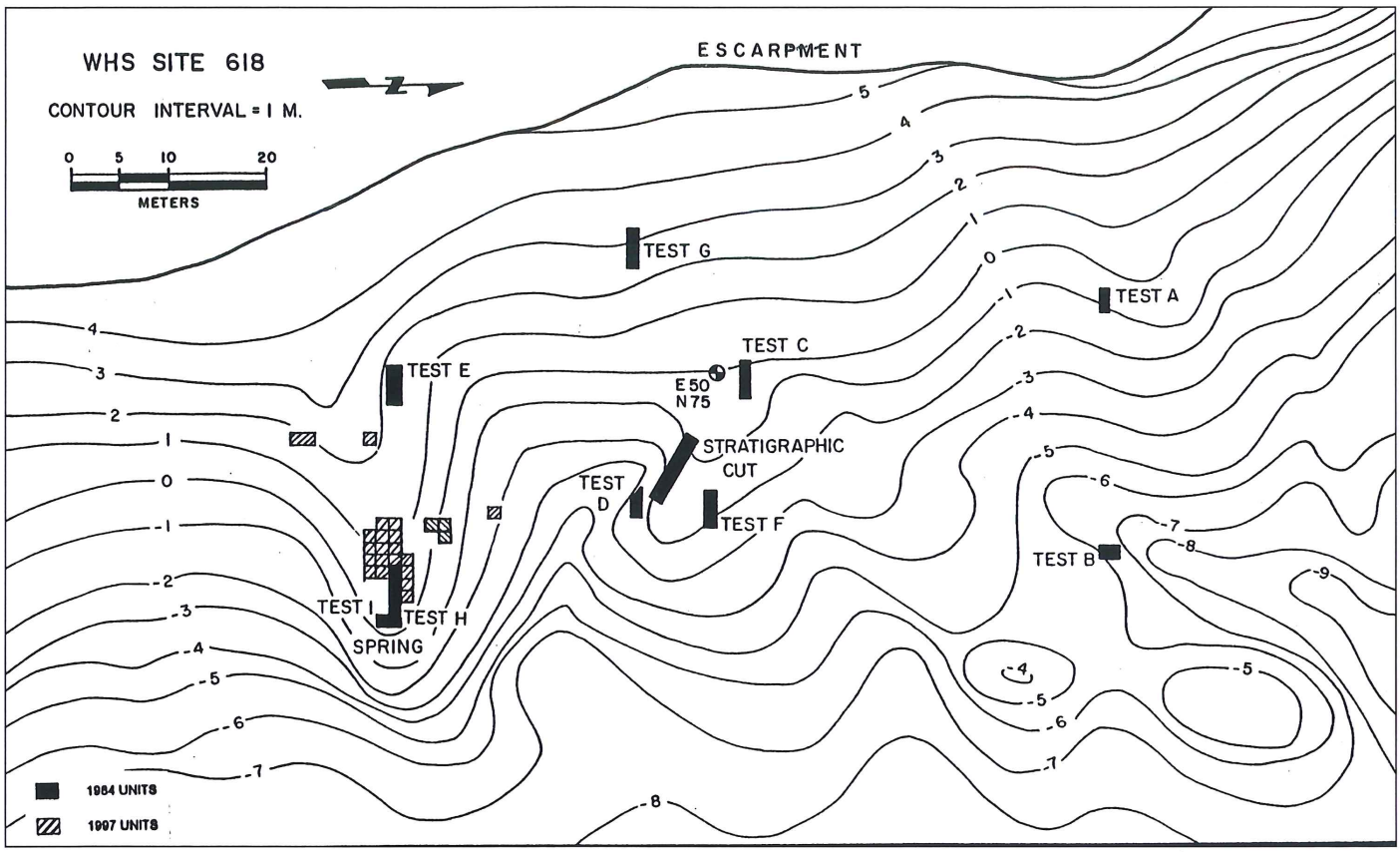


7. *Surfer* map showing major tool distributions on a contour map of faunal weights comprised of animal bone at Locus C, Tha'lab al-Buḥayra (EHLPP2). (Contour levels = 50g).

press; Olszewski *et al.* 1998). The site consists of extensive colluvial slope deposits marked by eroding gullies leading down to the former shoreline of the Pleistocene lake (FIG. 8). At this locale, however, a very prominent perennial spring, demarcated by a well-preserved formation of interstratified lacustrine, spring tufa, and marsh or pond sediments, has been identified in the southernmost portion of the site. Dark marshy organic sediments found in the area of Test F to the north of the spring, as well as those interstratified within the spring tufa formation, indicate the likelihood of a spring-fed freshwater pool at this locale along the margins of the lake. Tiny freshwater snails are abundant in the sediments, especially at the spring, but no fish remains have been recovered to date.

Extensive surface assemblages and evidence from subsurface testing across the site in 1984 (Clark *et al.* 1988) and in 1997 (Olszewski *et al.* 1998) document a series of occupations at the site. The lithics collected from surface and subsurface areas represent a long technological sequence. A transitional Middle/Upper Paleolithic and Early Ahmarian component is represented solely by a deflated, remnant surface assemblage in the lower, northern portions of the site that are comprised of Levallois elements, transitional Levallois-like points, a single Emirah point, as well as Early Ahmarian el-Wad points. Better documented subsurface assemblages represent middle to late Upper Paleolithic components in Areas C, F, and in the southernmost area of the site where the spring tufa formation is located.

Radiocarbon dates are available for some areas of 'Ayn al-Buḥayra (TABLE 3). Area C has not produced a date, but the marshy organic sediments that characterized Area F have been dated to 25,950 ±440 bp (Beta 55928). In the southern portion of the site at the spring (formerly referred to as areas H and I), four radiocarbon dates have been obtained from the stratified sequence of lacustrine marls, spring tufas, and cultural sediments. The stratigraphically lowest date at the spring tufa formation is 23,560 ±250 bp (Beta 55931), which dates an underlying organic marsh silt band that occurs between layers of marls and is ca. 20cm below the lowest known cultural deposits in the area of the spring. Above this is an early occupation that is located between 60-80cm below the surface. A 1x1m test unit excavated in 1997 revealed an

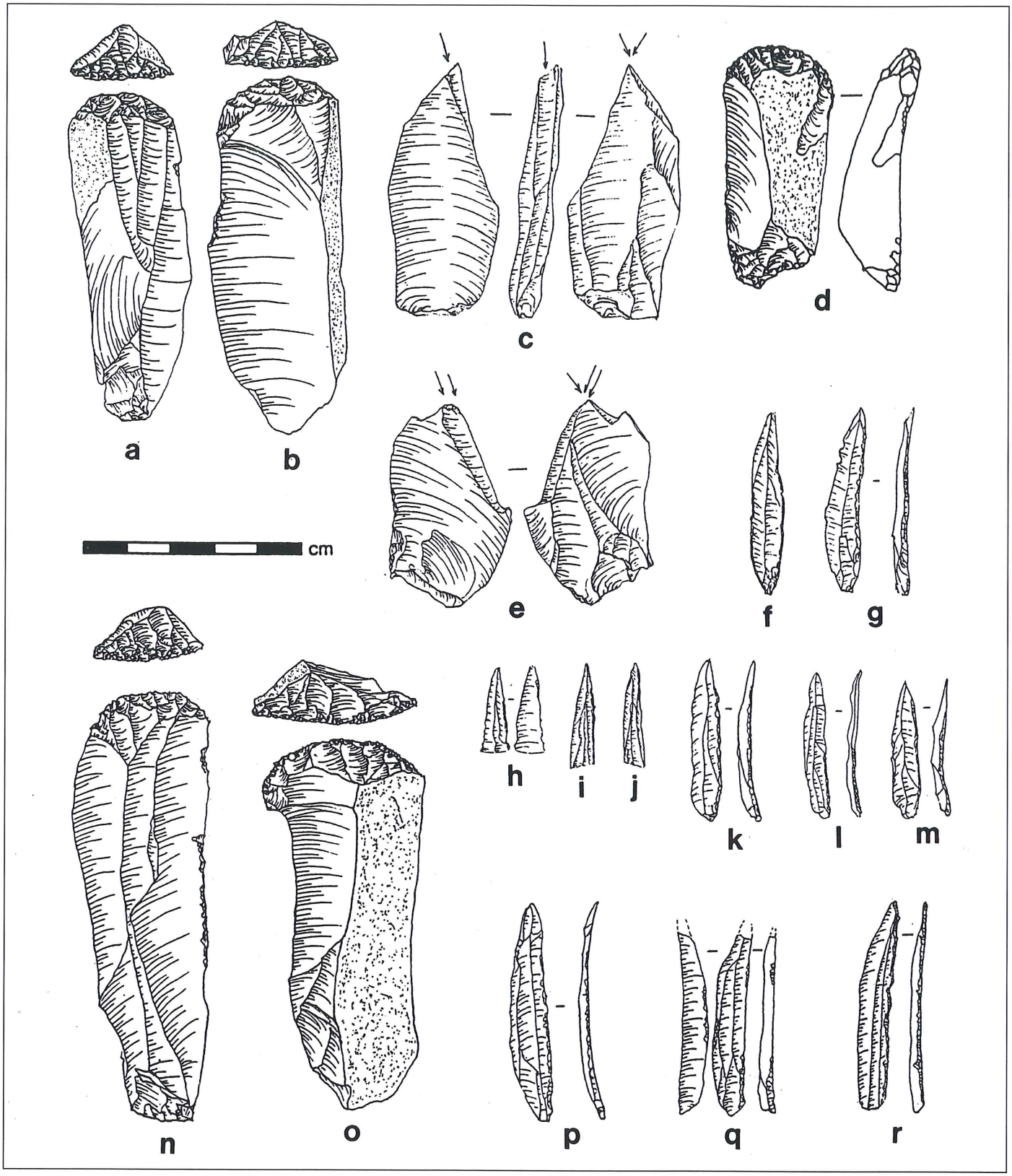


8. Map of 'Ayn al-Buḥayra (WHS 618) showing the main areas of the sites and the locations of excavation units during the 1984 (solid) and 1997 (hatched) seasons.

assemblage dominated by the remains of large fauna and undiagnostic lithics. Directly above this early occupation at ca. 60cm below the surface, soil sediments have been dated to 18,960 ±580 bp (Schuldenrein and Clark 1994: 34). This is clearly anomalous since it is succeeded by a cultural hiatus and consolidated, inter-stratified tufa and marl sediments some 25cm thick. These, in turn, are overlain by a well-dated Late Ahmarian occupation. This occupation is characterized by loose cultural sediments containing a high density of lithics and a well-preserved faunal assemblage in association with numerous remnant hearths, three of which have been radiometrically dated. One, dated to 23,500 ±270 bp (Beta 56424) was exposed on the south side of the tufa formation (Schuldenrein and Clark 1994: 34). Another hearth (Feature 1, Test I, E76, N39) has been dated to 20,300 ±600 bp (UA 4395) (Clark *et al.* 1988: 240; Schuldenrein and Clark 1994: 34). Charcoal-laden sediments from a third hearth (Feature 2, E68,N42) date to 20,670 ±600 bp (Beta 118757).

The lithics in areas C and F are generally quite similar, and they differ in some respects to those recovered from the later occupation at the Spring area (Coinman 1993). In Area C, there is a well-developed blade/bladelet technology with a greater emphasis on larger blades than bladelets, greater numbers of burins and endscrapers, and a small proportion (6.1%) of the small, finely retouched Ouchtata bladelets and points[2] (FIG. 9). The main difference between Area C and the assemblage at the Spring resides in the composition and typology of the tools (TABLE 5). Area C is dominated by larger, heavier types of tools, such as endscrapers, burins, and variously retouched blades and flakes, comprising 60% of the tools. This contrasts with about 40% of these larger tool types in the assemblage recovered from the Spring, where the retouched tools are overwhelmingly dominated by Ouchtata bladelets and points (58%) (discussed in greater depth below). Although Ouchtata retouched pieces occur in Area C, retouched bladelets, in this part of the site, in general, comprise only 13%. Therefore, the technology represented at Area C is clearly Ahmarian in its emphasis on blade and bladelet production, but the two areas of the site differ in the frequency of bladelet tools, which are

[2] Ouchtata refers to a very fine, graded retouch, following the original use of the term by Tixier (1963) and subsequently used to describe finely retouched bladelets at sites in the Negev (Marks 1976: 377; Ferring 1977: 97)



9. Artifacts from ʻAyn al-Buḥayra (WHS 618): a, d – endscrapers from Area C; b, n, o – endscrapers from the Spring Area; c, e – burins from Area C; f-m, p-r – Ouchtata points from the Spring Area.

TABLE 5. Artifact Frequencies for the Spring Area and Area C at 'Ayn al-Buḥayra (WHS 618).

Ain al-Buhayra (WHS 618)	Spring		Area C	
	n	%	n	%
Debitage				
Cores	121	.9	202	1.6
Blades	1049	7.9	1725	13.6
Bladelets	2576	19.5	2154	17.0
Flakes	4324	32.7	2152	16.9
Core Trimming Elements	140	1.1	198	1.6
Burin Spalls	57	.4	59	.5
Microburins	0	-	5	.03
Trimming Flakes (<2cm)	4970	37.5	6185	48.7
Other Debitage	0	-	31	.2
Total	13237	100.0	12711	99.93
Debris				
Shatter	2554	100.0	10,695	100.0
Retouched Tools				
Scrapers	66	10.5	122	13.0
Burins	25	4.0	89	9.5
Perforators	2	.3	21	2.2
Truncations	10	1.6	142	15.2
Notch/Denticulates	5	.8	51	5.4
Composite Tools	5	.8	20	2.1
Retouched Blds/Blds	58	9.2	69	7.4
el-Wad Points	31	4.9	8	.9
Ouchtata Bladelets	390	62.0	45	4.8
Backed bladelets	0	-	11	1.2
Other Retouched Pieces	37	5.9	357	38.2
Total	629	100.0	935	99.9%

offset by the larger, heavier types of tools in Area C. These differences may signify both functional differences in the tool kit as well as potential changes in time in which the late Ahmarian technology becomes more focused on small retouched bladelets that could be one of the technological predecessors of Epipaleolithic backed microliths.

Important differences between the earlier occupation at Area C and the later occupation at the Spring are apparent in other aspects of their assemblages. Faunal remains are almost non-existent from Area C with only three equid tooth fragments recovered in the 1984 excavations (Clark *et al.* 1988:242). Densities of lithics, however, are much greater in the Area C units and primary reduction activities are reflected in high proportions of cores and core trimming elements (3.1%) and 8.1% primary elements. This is comparable to the evidence for reduction activity at Tha'lab al-Buḥayra, Locus C, discussed above, as well as with the Spring area, discussed below. Since there is no evidence for hearths or a preserved faunal assemblage at Area C, it is impossible to infer with confidence the nature of activities that occurred in this area of the site ca. 25,000 bp.

The Spring area of 'Ayn al-Buḥayra provides a striking contrast with the rest of the site in that the cultural deposits are essentially *in situ,* interstratified within a preserved outcrop of lacustrine and spring tufa deposits. In contrast with the lithics from Area C and F, those from the Spring area have extremely fresh edges and, in conjunction with non-lithic artifacts, exhibit spatial distributions that suggest discrete activity areas associated with a series of hearths. The technology and typology at the Spring is best described as *Late* Ahmarian because it exhibits technological continuity and typological change

from the Early Ahmarian blade technology and point typology. The initial Early Ahmarian focus on the production of elongated blanks (el-Wad points) documented in the upper levels at Ṭūr Ṣadaf rockshelter continues into the Late Ahmarian, but the later technology and typology encompasses a greater emphasis on increasingly smaller bladelet debitage for the purpose of producing small, finely retouched pointed implements – the Ouchtata points. Cores are principally single platform blade/bladelet cores with regularized platform edges. As in Early Ahmarian core technology, the core tablet continues to be the preferred method of platform rejuvenation. The most distinguishing artifacts that characterize the Late Ahmarian are the Ouchtata points (see FIG. 9h-m, p-r). To date, 56 complete points have been recovered in which the retouch occurs on the obverse, right edges, primarily along the lower portions and the proximal ends. An additional 379 fragments document the distinctive size, shape, and retouch of the complete points. Viewed from an evolutionary perspective, these points appear to be evolved technologically from the Early Ahmarian pointed implements, the el-Wad points (Coinman 1997b, 1998).

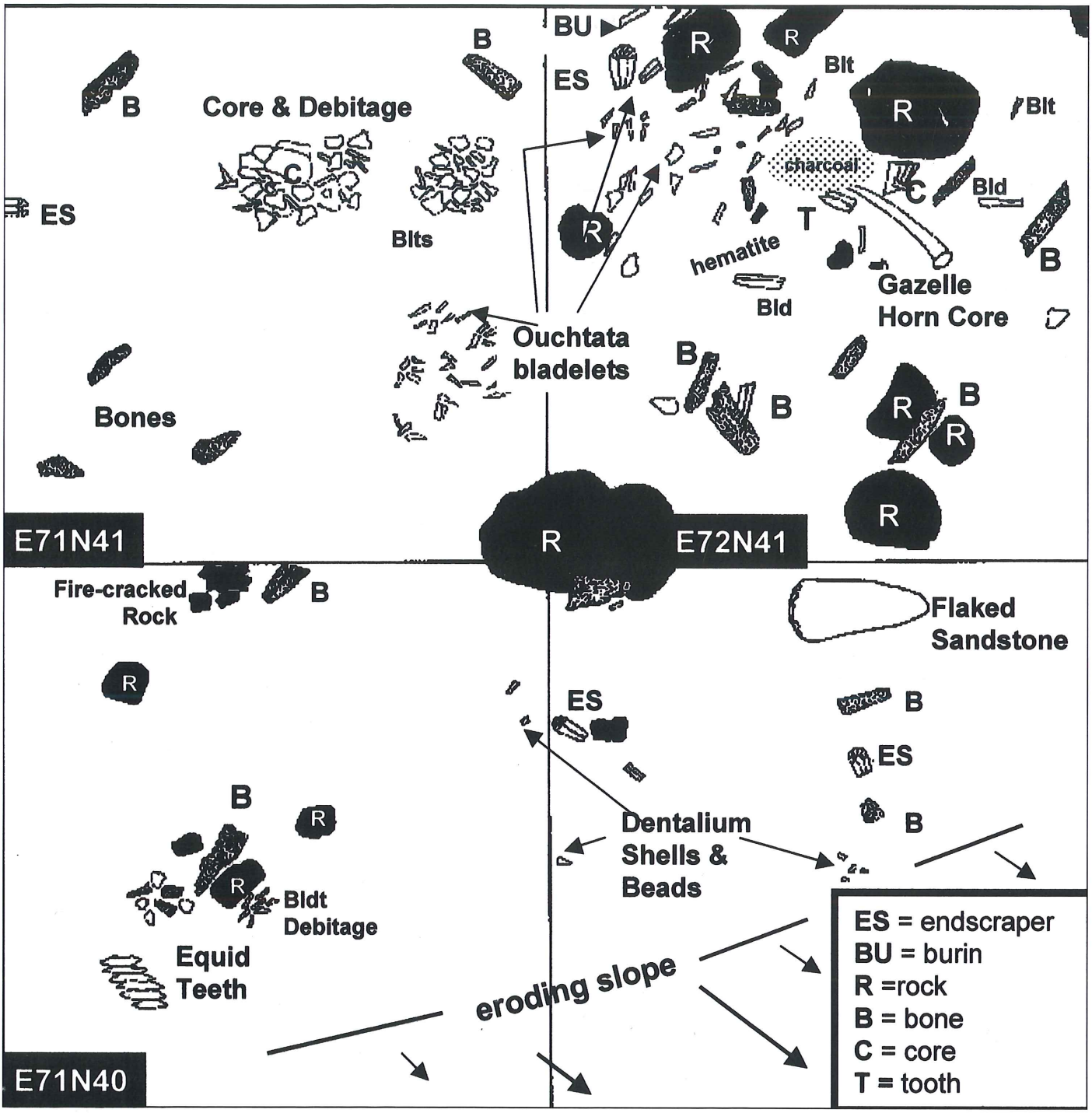
The fauna at the Spring are exceptionally well-preserved and abundant. The 1997 faunal sample from the Spring represents approximately 14 kilograms of bones and teeth from sixteen $1m^2$, most of which were excavated to a depth of about 30cm. Four contiguous units with one hearth in the center (Feature 2, E68, N42) contained the largest concentration of faunal remains with over six kilograms of bones and teeth. The assemblage as a whole represents large mammals, such as equids and bovids. The 1984 sample from the Spring consists almost entirely of equid and *Bos primigenius* teeth and fragments, with only one of the equid teeth identified specifically as *Equus hemionus/asinus* (Clark *et al.* 1988: 242). The 1997 season recovered another 28 complete teeth, which are all equids with the exception of one young bovid. The remaining faunal specimens appear to be dominated by foot and leg elements and fragments, many with articular ends (Thompson 2001: 93). Butchering marks are present on a number of specimens. A single horn core, that of a gazelle, has been recovered, and only about 11% of the identifiable faunal remains are those of gazelle (Thompson 2001: 94). Rare examples of worked bone tools representing awls, points, and an enigmatic serrated pointed implement have been recovered (Coinman 1997c), as well as ostrich eggshell, dentalium shell beads, and abundant red ochre in the form of small nodules and stained sediments.

Mapping the distributions of artifacts and gross faunal weights has resulted in defining a number of discrete activity areas at the Spring area. Primary reduction elements are similarly high as those recovered from Locus C at Tha'lab al-Buḥayra, with these two sites exhibiting the highest frequencies of initial core reduction. Cores, core trimming elements, and cortical flakes and blades are distributed in at least one cluster around one of the hearths (Feature 2) with a rock windbreak to the east (E68, N42). Included in this area with these primary reduction elements are two hammerstones and dense faunal remains. Limited numbers of tools are associated with this hearth, while higher frequencies and clusters of endscrapers, burins and Ouchtata bladelets have been mapped around another possible hearth three meters to the east, which is undated and characterized by dense sediments of fine charcoal (FIG. 10). In this area of approximately four square meters, there are also cores and associated concentrations of small debitage, flat anvil stones, relatively dense bone fragments, teeth, a gazelle horn core, and examples of worked bone. It is this area where dentalium shells and beads have also been recovered and the remains of ostrich eggshell fragments. The highest concentrations of tiny bladelets and points with Ouchtata retouch are found in the southern units, while burins are clustered in the northern units, and endscrapers to the north and to the southwest.

A third hearth was uncovered in the initial excavations (1984) in Test I (E76,N39) where only limited artifacts were found, but the fragments of possible antler punch were recovered near the hearth. This area of the site with the evidence for the fourth hearth has since eroded away. Thus, the Spring Area of 'Ayn al-Buḥayra records a variety of activities associated with hearths, faunal remains, and specialized tools, but in contrast to Tha'lab al-Buḥayra, the predominant specialized tools tend to be smaller points rather than scrapers and truncations. The Spring area at 'Ayn al-Buḥayra appears to record activity areas with a wider spectrum and diversity of artifacts than has been found at Tha'lab al-Buḥayra. Together though, these two sites with more or less *in situ* assemblages preserved in lacustrine sediments provide the best evidence for both intra- and intersite activities in al-Ḥasā during the middle to late Upper Paleolithic.

Significance of the Paleolithic Sites in al-Ḥasā

Upper Paleolithic sites in significant numbers have been found in association with Pleistocene lacustrine and marsh ecological settings, but such geoarchaeological contexts in the Levant have been greatly overlooked and understudied. Current research on the faunal remains recovered from lakeshore sites in al-Ḥasā, however, suggests there is a wealth of information on late Pleistocene subsistence strategies that is well-preserved in such lacustrine geological sediments and which has been missing or poorly preserved at open-air archaeological sites in most regions of the Levant during this time period. Thus, Wādī al-Ḥasā with its abundant archaeological sites and extensive geological remnants of the Pleistocene provides



10. Artifact distributions in four units at the Spring Area of 'Ayn al-Buḥayra (WHS 618).

some of the best paleoenvironmental contexts in which to study late Pleistocene hunter-gatherer ecological strategies. This would greatly enhance our current understanding and limited reconstructions of human subsistence strategies during this well-documented but little understood time period prior to the onset of the Holocene and the advent of early agriculture. In addition, radiometrically dated sediments at Tha'lab al-Buḥayra and 'Ayn al-Buḥayra document a sequence of lacustrine deposits from at least 26,000 bp to 20,000 bp, after which the lake appears to recede permanently and is replaced by localized marshy environments.

The lithic assemblages recovered from Ṭūr Ṣadaf rockshelter provide important new data for understanding the Middle to Upper Paleolithic transition and the earliest Upper Paleolithic in the larger Levant. On the basis of excavations to date, the technological sequence at Ṭūr Ṣadaf appears to be unique in that it encompasses the actual transition and emergence in a single stratigraphic sequence of what is known throughout the Levant as the Early Ahmarian blade technology. The occupation sequence at Ṭūr Ṣadaf may represent one of the only known sites where an Early Ahmarian assemblage is found stratigraphically overlying materials of a transitional nature. It thus affords us one of the best opportunities to understand the nature and timing of the transition from the Middle Paleolithic to the emergence of an Early Upper Paleolithic technology, which is generally correlated "modern" behavior. Although the rockshelter is small, there are significant cultural deposits that remain to be excavated and which may provide additional evidence for intra-site features that could help define more clearly site function and potential climatic and subsistence differences between early and later phases of the Upper Paleolithic, especially at sites found clustered around Lake Hasa.

At the lakeshore sites of Tha'lab al-Buḥayra and 'Ayn al-Buḥayra, the faunal assemblages are significantly large and well-preserved, providing the most extensive faunal remains for the Levantine Upper Paleolithic and allowing us to make a major contribution to understanding subsistence strategies to a degree not found at other known sites, particularly those in marginal desert zones. The dental remains of equids are some of the best preserved and largest collection recovered. Based on preliminary examinations of dental morphology, the teeth provide a large sample for potentially distinguishing equid species at sites in the southern deserts. Identifying the presence of *E. caballus* in the eastern deserts during the late Pleistocene has been tenuous, while distinguishing between *E. asinus* (wild ass) and *E. hemionus* (onager) is often difficult (Davis 1980:297; Martin 1998: 161-162). However, specific dental markers may distinguish *E. asinus /E. hemionus,* as well as distinguish these two from the more zebra-like species, *E. hydruntinus* and the wild horse, *E. caballus* (Davis 1980: 293-294).

Taken together, the lithic assemblages from all three of these sites are some of the most interesting and in many ways, unique to the Levantine Upper Paleolithic. Ṭūr Ṣadaf, as mentioned above, reveals a transitional sequence that informs on the technological evolution from flake and blade based late Middle Paleolithic technologies to smaller blade and bladelet based early Upper Paleolithic technologies. The lithics recovered from Tha'lab al-Buḥayra establish a well-dated late phase of the Early Ahmarian ca. 26-24,000 bp, which is not well documented elsewhere and which is relatively close in time to the Late Ahmarian at ca. 20-19,000 bp. 'Ayn al-Buḥayra, on the other hand, has produced some of the rarest evidence for a discrete late Upper Paleolithic technological stage that was focused on small bladelet points. These small points are technologically distinct from the backed microlithic technologies that subsequently characterize the Epipaleolithic assemblages, some of which have been found at sites in al-Ḥasā and overlap temporally with the Late Ahmarian (see Olszewski in press; al-Nahar 2000).

Although survey and excavations in Wādī al-Ḥasā began in the late 1970s and early 1980s and have provided a large portion of what we know about Jordan's paleolithic, we have barely 'scratched the surface' on the archaeological record in this one area of Jordan. Future work will be directed at collecting additional information on the closely interrelated organization of settlement patterns, subsistence strategies, and adaptive technologies in and around one of the Levant's most prominent Pleistocene lake and marsh settings.

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