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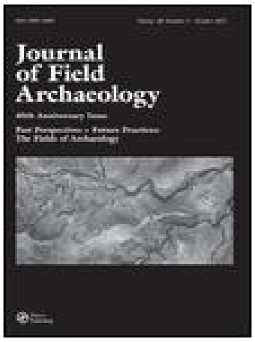

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Technological Change and Economy in the Epipalaeolithic: Assessing the Shift from Early to Middle Epipalaeolithic at Kharaneh IV

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ABSTRACT
Epipalaeolithic hunter-gatherer communities in the Southern Levant exhibit numerous complex trends that suggest that the transition to the Neolithic was patchy and protracted. This paper explores the changing nature of occupation at the Epipalaeolithic site Kharaneh IV, Jordan, through an in-depth analysis of the lithic and faunal assemblages. Focusing on the analysis of a single deep sounding (unit AS42), we address how Kharaneh IV occupations link to the local landscape and environmental changes. As an aggregation site, Kharaneh IV represents an interesting locale to explore the changing nature of aggregation and social cohesion prior to the origins of agriculture, as well as changes in technology and subsistence between the Early and Middle Epipalaeolithic. We explore the tempo and nature of transition from one archaeological culture to the next through changes in technology and how this reflects the people making and using tools, to understand how foragers adapted to a changing landscape.

KEYWORDS
Epipalaeolithic; lithic analysis; faunal analysis; hunter-gatherer aggregation; cultural change

Introduction

Hunter-gatherer groups occupying the Southern Levant during the Late Pleistocene sit at the debated threshold of some of the most impactful changes in human history: the origins of sedentism and the origins of agriculture, associated with the Neolithic period (ca. 11,500 CAL B.P.). These Epipalaeolithic hunter-gatherers (21,000–11,500 CAL B.P.) predate the Neolithic by several thousands of years, yet exhibit complex social, technological, and ideological behaviors that precede these seemingly revolutionary changes. The Late Epipalaeolithic Natufian culture was long seen as a precursor to the Neolithic, demonstrating nascent cultural patterns common to later periods, such as burials with symbolic grave goods, stone structures, sedentism, and incipient domestication (Bar-Yosef 1998; Bar-Yosef and Belfer-Cohen 1991; Belfer-Cohen 1995; Byrd 2005; Davis and Valla 1978; Goring-Morris and Belfer-Cohen 2011; Grosman et al. 2008; Lieberman and Bar-Yosef 1994; Nadel et al. 2013; Valla and Bar-Yosef 2013). However, recent research has shown that these patterns existed earlier, tracing threads of these Neolithic behaviors earlier than the Natufian, into the Early and Middle Epipalaeolithic (Dubreuil and Nadel 2015; Maher, Richter, Macdonald, et al. 2012; Maher, Richter, and Stock 2012; Olszewski and al-Nahar 2016; Sterelny and Watkins 2015; Watkins 2010). These include early structures (Maher, Richter, Macdonald, et al. 2012; Nadel 2002; Nadel et al. 2004; Nadel and Werker 1999; Yeshurun et al. 2015), burials within houses (Lisa Maher, Danielle Macdonald, Emma Pomoroy, and Jay T. Stock, personal communication 2018), increasingly social relationships with animals (Maher et al. 2011), use of personal ornamentation (Kuhn et al. 2001; Richter et al. 2011), increasing sedentism (Maher, Richter, Macdonald, et al. 2012), and symbolic artifacts (Gregg et al. 2011; Hovers 1990; Kaufman et al. 2018; Maher, Richter, Macdonald, et al. 2012; Yaroshevich et al. 2016). Thus, as we have long suspected but can now empirically demonstrate, the hunter-gatherers occupying the South Levantine landscape during the Early and Middle Epipalaeolithic were not simple hunter-gatherers, but multifaceted peoples with nuanced and complex ways of life exhibiting early traces of behaviors that compose the Neolithic package.

Through an in-depth analysis of the chipped stone lithic assemblage and associated fauna—the two most abundant categories of Epipalaeolithic material culture—this paper explores the changing nature of occupation at the Early/Middle Epipalaeolithic site Kharaneh IV, Jordan. We hypothesize that changing cultural trends at Kharaneh IV correlate to changes in the local environment. Focusing on the analysis of a single deep sounding in excavation unit AS42, we address how Kharaneh IV occupations link to the local landscape and environment through analysis of material culture and faunal changes over time. To date, this is the only excavated trench at Kharaneh IV with clearly stratified Early and Middle Epipalaeolithic occupations. As an aggregation site, Kharaneh IV represents an interesting locale to explore the changing nature of occupation prior to the origins of agriculture through changes in technology and animal use. Lithic technological changes highlight the shift from non-geometric to geometric microliths and place these microliths in context with how culture is conceptualized and constituted during the Epipalaeolithic (Dobres 2000). Through understanding the transitions between different cultural industries at the site, we can explore the tempo and nature of transition from one archaeological culture to the next and how this relates to changes in the landscape where people interacted.

The Epipalaeolithic

The Epipalaeolithic, in its original definition, is characterized by hunter-gatherers using microlithic tools (Bar-Yosef 1970;

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Perrot 1966; Tixier 1963). Although it is now recognized that the Epipalaeolithic includes other diverse types of material culture, it is these microlithic tools that define boundaries between archaeological groups; different forms of microliths and frequencies of tool types delineate discrete archaeological entities. Lengthy debates about what scale of variability should constitute a new Epipalaeolithic culture have resulted in two primary camps of typological organization: those who split the archaeological record into a wide diversity of different entities based on a finer scale of variability (Bar-Yosef 1970; Goring-Morris 1987; Goring-Morris and Belfer-Cohen 1998; Henry 1989, 1995); and those who lump artifacts at the coarser scale, suggesting that there is inherent variability within a single cultural practice (Goring-Morris et al. 2009; Maher et al. 2016; Maher and Macdonald 2013; Olszewski 2006, 2001, 2011). Through a lumper's lens, Early Epipalaeolithic groups are characterized by the dominance of non-geometric microliths in the lithic assemblage, Middle Epipalaeolithic groups by geometric microliths such as trapeze-rectangles, and Late Epipalaeolithic groups by lunates.

The nature of the transition from Early to Middle to Late Epipalaeolithic assemblages, documented at several multi-component sites such as Kharaneh IV (Maher and Macdonald 2013; Muheisen and Wada 1995), Jilat 6 (Garrard and Byrd 2013), and Ein Qashish (Yaroshevich et al. 2016), poses an interesting question. Do these on-site transitions represent a local development into new technological forms, suggesting the invention of new microlith types at multiple centers around the region? Or are new forms invented in a single region and then spread from that location, either through the spread of ideas or the spread of people? The multiple-center hypothesis is strengthened when one considers ongoing regional interaction in the Levant, where ideas could be easily shared and adapted between different groups, allowing for the development of similar ideas and technologies in multiple locations. The second hypothesis is formulated on a hierarchical, down-the-line style of interaction, with a central point of origin. These ideas have been seen in early arguments for cultural diffusion during the Epipalaeolithic. For example, previous arguments had been made that the Geometric Kebaran culture was a development from the Kebaran culture of the Mediterranean zone of the Levant, and that these Geometric Kebaran populations spread into more arid regions during the climatic amelioration of the Bølling-Allerød (Bar-Yosef and Belfer-Cohen 1989). However, evidence has shown numerous examples of Early Epipalaeolithic communities in the arid regions of the Levant and, as discussed here, sites like Kharaneh IV contain stratified Early and Middle Epipalaeolithic occupations, suggesting the possibility for local, incipient development of Middle Epipalaeolithic cultures outside of the Mediterranean zone.

Many of the complex Epipalaeolithic practices mentioned previously, such as increasing sedentism, symbolic artifacts, houses, and personal ornamentation, are witnessed in the archaeological assemblage of Kharaneh IV, a large Early and Middle Epipalaeolithic aggregation site in the eastern desert of Jordan. This site represents an excellent example of a multicomponent Epipalaeolithic site, with both Early and Middle Epipalaeolithic occupations. The large extent of Kharaneh IV and the diversity of material culture suggests it was an aggregation locale for Epipalaeolithic groups from across the region. Through this lens, the archaeological assemblages signify the interaction of numerous communities who congregated at the site on a repeated and multi-seasonal basis, attracted to a local habitat rich in fauna and flora (Maher et al. 2016). As well, the deep accumulation of cultural material suggests that these interactions persisted over time. Changes in the *chaîne opératoire* from the Early to the Middle Epipalaeolithic illuminate different technological strategies employed by the inhabitants of Kharaneh IV over time, and when paired with evidence of a changing environment, they highlight shifts in communities at the site that reflect both local adaptations to fluctuations in the surrounding habitat and changes in social relationships between aggregating community members.

Kharaneh IV Background

Environment

The multi-component Early and Middle Epipalaeolithic site Kharaneh IV is located in the Azraq Basin, eastern Jordan (FIGURE 1). Radiocarbon dates place occupation of the site between 19,830–18,600 CAL B.P., suggesting that habitation of the site was relatively brief (in archaeological terms), but clearly intensive (Richter et al. 2013). The site is situated on the northern bank of the Wadi Kharaneh, one of many shallow, seasonal rivers that flow east towards the Azraq Oasis.

Although the modern environment around Kharaneh IV is an arid desert, extensive off-site geomorphological work paired with on-site geoarchaeological analyses indicate a local paleoenvironment that would have been substantially different at the time of occupation. Test trenches in terraces at several off-site locations reveal marl deposits surrounding Kharaneh IV with OSL dates between 23 and 19 kya (Jones et al. 2016). Deposition of these marls, subsequent carbonate development, and an abundance of low-velocity, freshwater ostracods are consistent with wetland deposits (including those documented in the Azraq Oasis [Jones and Richter 2011]), indicating the presence of extensive marshland habitats adjacent to Kharaneh IV during the earliest occupation of the site (Jones et al. 2016). Surrounding this wetland was a combination of open grasslands and parkland, making the immediate area rich in a wide variety of floral and faunal resources (Bender 1974; Garrard et al. 1994; Garrard and Byrd 2013; Jones et al. 2016; Yeshurun et al. 2015). Being situated near both wetland and steppe/parkland resources allowed the inhabitants of Kharaneh IV to access reliable sedges and reed resources from the wetland, while simultaneously exploiting riskier seasonal grasses and cereals from the steppe (Ramsey et al. 2016). At the base of the Early Epipalaeolithic cultural layers, underlying wetland deposits show both: artifacts interstratified with carbonate-concreted, light-colored marls rich in ostracods that match the marl deposits surrounding the site; and a more abrupt boundary with a massive clay-rich, brown deposit, likely representing a localized area of more open lake-like water within the wetland (Jones et al. 2016). This suggests that people were living directly adjacent to the water source, occupying dry land next to the wetland as the shoreline fluctuated. This rich local environment would have been an attractive locale during the site's occupation, a stark contrast to the current aridity of the area.

Evidence for drying of the wetlands begins sometime in the Early Epipalaeolithic, and continues throughout the

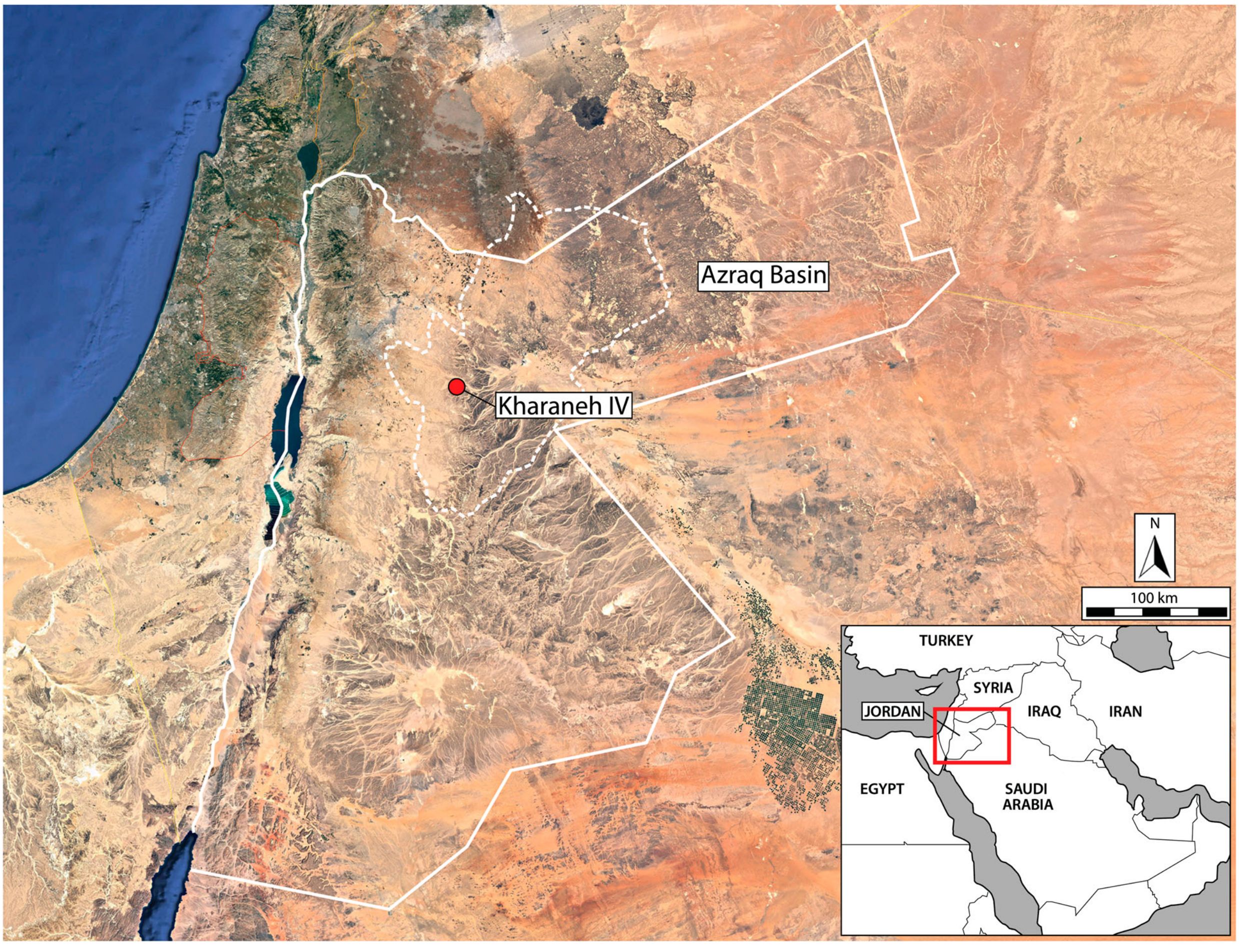

Figure 1. Regional map of the South Levant showing location of Kharaneh IV.

Middle Epipalaeolithic occupations, as documented by extensive carbonate development within the uppermost wetland marls during cycles of inundation and drying. Occupation of the site halted abruptly around 18 kya, with no subsequent re-occupation, and no other archaeological traces in the surrounding area until into the Holocene. This corresponds to off-site terrace stratigraphy, which shows a prolonged erosional unconformity (Jones et al. 2016).

Kharaneh IV

Kharaneh IV was originally described in English archaeological publications by G. Lankester Harding, who explored the region in the 1930s and 1940s, and described it as " … a magnificent Upper Palaeolithic–Mesolithic site, where the ground is covered with thousands of flint implements and flakes" (1959: 146). The site was subsequently systematically surveyed by A. Garrard and N. Stanley-Price in the mid-1970's (Garrard and Stanley-Price 1977). Initial excavations of the site were conducted as two brief field seasons by M. Muheisen from Yarmouk University in the 1980s (Muheisen 1983, 1988c). Muheisen excavated three small soundings spread out over the surface of the mound (R/S2/60, DI/40, and K3/60), one of which he expanded in the second field season (DI/40) (Muheisen 1988a, 1988b; Muheisen and Wada 1995). Current excavations are being conducted at the site by the Epipalaeolithic Foragers in Azraq Project (EFAP) and have been ongoing since 2008 (Maher and Macdonald 2014; Maher et al. 2007). Besides the Early and Middle Epipalaeolithic deposits at the site, there is no evidence for other occupations at Kharaneh IV. Neolithic and later material can be found on terraces across the Wadi Kharaneh, on its south bank, and to the north of the site near Qasr Kharaneh.

Kharaneh IV is an exceptionally large Epipalaeolithic site, approximately 21,000 m^2 in size, making it one of the largest Terminal Pleistocene occupations in the Levant. The site's large size and dense artifact accumulations indicate that it was a hunter-gatherer aggregation locale during occupation and a focal point for interaction in the region. The deflated surface of Kharaneh IV has created a pavement of lithics capping the site and this accumulation of artifacts has protected the subsurface deposits from erosion. As a result, the subsurface deposits are extremely well-preserved and also exceptionally dense in artifacts, including chipped stone tools and debris, groundstone, faunal remains, and marine shells, creating a low mound of occupational deposits in the otherwise eroding desert landscape. Cultural material at Kharaneh IV extends to a depth of approximately 2.4 meters below the surface, with no evidence to date of a substantial depositional hiatus, suggesting intensive occupation for the 1200 years that the site was occupied. This intensive occupation was likely characterized by repeated periods of multi-seasonal site habitation, some of which may have been prolonged.

Kharaneh IV has two peaks on its mounded surface, one on the west and one on the east side of the site (FIGURE 2). During the initial 1980s excavations, test trenches were placed on top of each peak (Muheisen 1983, 1988c), with a third to the north of eastern mound peak. Renewing excavations in 2008, EFAP reopened Muheisen's trenches on the east and west peaks of the site and placed new excavation units around

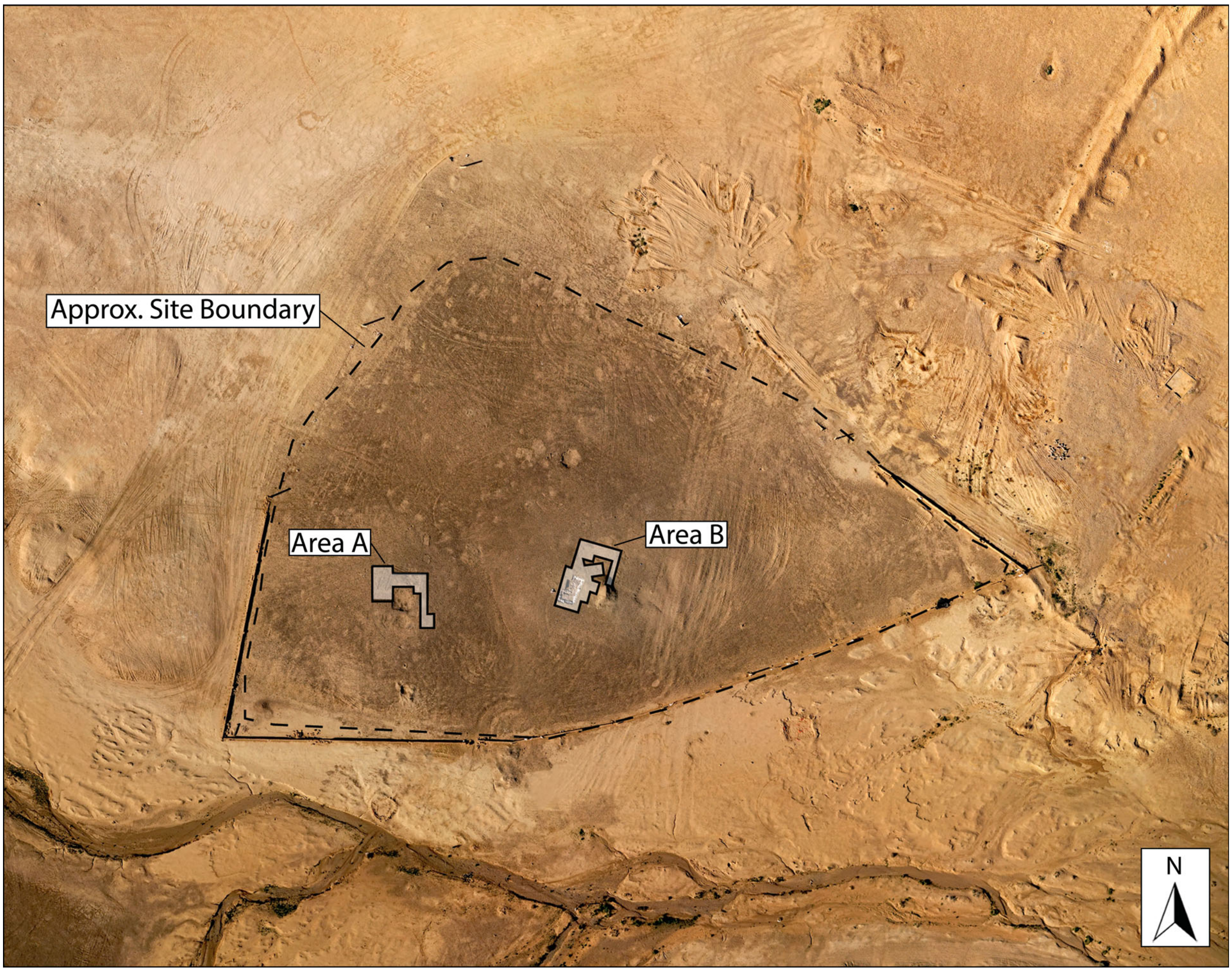

Figure 2. Map of Kharaneh IV showing excavation areas A and B.

the former excavation areas to trace the deposits identified in the initial excavations. The initial goals of these excavations included expanding on Muheisen's original areas by tracing the horizontal exposure of deposits in the east and west sides of the site in an attempt to identify similar features to those identified by Muheisen such as hearths, postholes, and occupation surfaces. In addition, we also excavated two deep soundings in the east and west areas to explore the depth of the deposits on site. Early Epipalaeolithic cultural material is located at the highest point on the site to the east (labeled Area B by EFAP) and there are no discernable overlying Middle Epipalaeolithic artifacts in this area of the site. Middle Epipalaeolithic artifacts were discovered on the western portion of the mound (labeled Area A by EFAP) and, until recently, these deposits were thought to be comparatively shallow and overlying sterile marl deposits, with no clear overlap or stratification between the Early and Middle Epipalaeolithic deposits on site. However, in this paper we show that indeed stratified Early Epipalaeolithic material is found below the later Middle Epipalaeolithic deposits in Area A.

Early Epipalaeolithic occupation

In the Early Epipalaeolithic area (Area B), renewed work by EFAP initially focused on a combination of horizontal and vertical excavations to trace the deposits excavated by Muheisen. Initial excavations by Muheisen uncovered dense cultural material in this area, which he called area R/S2/60, along with several unique features such as a possible hut structure (that has now been confirmed). In addition, during the 1980's excavations, two human burials were discovered in these deposits. Returning to the site in 2008, EFAP continued excavations in the area around where the burials were discovered in the hope of identifying additional human remains. These renewed excavations of Area B revealed several pit features, compacted surfaces, hearths, middens, and ash dumps (Maher, Richter, Macdonald, et al. 2012). The dense accumulation of material in this eastern area of the site indicates extensive and varied occupation by the Early Epipalaeolithic people of Kharaneh IV.

During the 2010 excavations, evidence for two hut structures were identified in the Early Epipalaeolithic deposits (Maher, Richter, Macdonald, et al. 2012). During Musheisen's work at the site he excavated the corner of Hut 1, exposing a small part of this feature, however it wasn't until 2010 that it was confirmed to be a hut structure. Continued excavations in 2013 identified a third hut feature that overlaps the southeast corner of Hut 1. Radiocarbon dates from above and below the floor of Hut 1 place the date between 19,400 and 18,800 CAL B.P. Phytolith analysis of the superstructure sediments from Hut 1 suggest that the occupants were utilizing a variety of wetland resources for the construction of the structure. Woody and shrubby dicots likely were used to construct the hut frame, while a variety of grasses, wetland reeds, and sedges were used as a covering, probably bundled as thatching to cover the frame (Ramsey et al. 2018). Deposits from the floor of the hut show a similar variety of grasses, wetland reeds, and sedges phytoliths, suggesting that the floor may have been covered with loose vegetation or matting to increase the comfort of the living space (Ramsey et al. 2018).

Excavations of Hut 2 commenced in 2015 and continued during the 2016 field season. This second structure, which has a roughly ovoid shape with a burned superstructure overlying compact floor deposits, has a similar depositional pattern to Hut 1. Unlike Hut 1, to date no concentrations of marine shells or large articulated faunal remains have been recovered from the superstructure. However, we discovered a human burial situated on the hut floor, beneath the burned superstructure (Lisa Maher, Danielle Macdonald, Emma Pomoroy, and Jay T. Stock, personal communication 2018). Analysis of this burial is ongoing and excavations of the structure's floor deposits will continue in future field seasons. The complex life-history of these seemingly simple brush huts—with the deposition of caches and repeated suites of artifacts and human burials—suggests that these structures were important locales for the people of Kharaneh IV.

Preliminary lithic analysis from the Early Epipalaeolithic deposits in Area B shows that 84% of the overall retouched assemblage is composed of microliths, and >50% can be confidently identified as non-geometric microliths (Maher and Macdonald 2013). These microliths are primarily gracile obliquely-truncated and backed bladelets, finely backed bladelets, and micropoints. The lithic reduction strategy was focused on using narrow chert nodules to produce gracile blanks that were retouched into microliths. Energy and design planning was loaded towards the beginning of the sequence, with most investment placed into core preparation instead of core maintenance.

Analysis of the faunal remains from Area B shows that the Early Epipalaeolithic foragers of Kharaneh IV were primarily focused on the procurement of a single animal taxon, the goitered gazelle (*G. subgutturosa*, 68% of NISP) (Adam Allentuck, personal communication 2018). The only other ungulate taxa identified in Area B, *Equus* sp. (4% of NISP) and aurochs (*Bos primigenius*) (< 1% of NISP) were prey of relatively minor importance. Carnivores are best represented by fox (*Vulpes vulpes*, 3.5% of NISP), with small quantities of medium-sized Canidae (dog/wolf/jackal) also identified. The Cape hare (*Lepus capensis*) is the most frequently occurring small game animal (6% of NISP). Six taxa were identified in a small collection of 30 bird bones. The largest of these taxa is ostrich (*Struthio camelus*). Smaller birds identified in Area B are eagle (*Aquila* sp.), heron (Ardeidae), rock dove (*Columba livia*), partridge (*Alectoris* sp.), and sandgrouse (*Pterocles* sp.). Tortoises (*Testudo graeca*) are very abundant, a fact, at least in part, attributable to the tendency of the bony plates of their shell to disarticulate after deposition. This process results in inflated tallies of their remains. Notwithstanding this caveat, tortoise remains comprise 17% of NISP from the Area B sample.

Middle Epipalaeolithic occupation

Muheisen's original excavations in the Middle Epipalaeolithic component of the site unearthed a variety of archaeological features, including what he identified as occupation surfaces, hearths, and postholes (Muheisen 1983, 1988b). He identified five hearths on a compact living floor surrounded by a series of small postholes 10–28 cm in diameter. These were interpreted by Muheisen to represent a possible hut feature surrounding the hearths. In 2008, a series of excavation units were placed around Muheisen's previous excavation unit to trace the extent of these features. This area was originally labeled "DI/40" by Muheisen, and has since been relabeled "Area A" for the new excavations. EFAP excavated the Middle Epipalaeolithic area for three field seasons in 2008, 2009, and 2010, and we have plans to continue further excavations in this area in the future. During the three excavation seasons in the Middle Epipalaeolithic area, several features were identified that correspond to those recorded by Muheisen. These features included three superimposed compact surfaces, three hearth deposits, and a series of dark brown sediment deposits interpreted as postholes.

The chipped stone tool assemblage from the Middle Epipalaeolithic occupation contains pieces representing the full chaîne opératoire, including tools, debitage, core trimming elements, and cores. The retouched tools are predominantly composed of microliths (83.4%), with similar representation of geometric (22.5%) and non-geometric microliths (19.7%) (Macdonald 2013). These similar frequencies are the result of very conservative identifications of tool types. All broken microliths were classified as fragmentary to limit misidentification of tool types; however, it is likely that many of the fragmentary microliths are actually broken geometrics. The geometric microliths are highly variable, but trapeze-rectangles predominate in the form of backed (8.5%) and unbacked trapezes (10.7%), and other variants. Analysis of the lithic assemblage indicates that although there are classic trapeze-rectangles, the assemblage is also composed of asymmetrical trapezoids, lunates, triangles, and a variety of other geometric forms (Macdonald 2013; Maher and Macdonald 2013; Muheisen and Wada 1995). These forms are found at other sites throughout the region, hinting at the possibility for multiple aggregating groups coming together with their own lithic traditions (Maher 2016; Maher and Macdonald 2013). Although there is flexibility in microlith types, there is less variability in the retouch style. The Middle Epipalaeolithic lithic assemblage shows evidence of all reduction stages including core preparation, maintenance, tool manufacture, and discard.

The faunal assemblage from the Middle Epipalaeolithic area is dominated by goitered gazelle (*Gazella subgutturosa*) at 90% of the assemblage (Martin et al. 2010; Spyrou 2015). Analysis of the gazelle remains for taphonomic processes suggests that there is no sign of carnivore activity, such as gnawing or digestion, on the bones (Spyrou 2015). There is a high frequency of shattered long bone fragments with green fractures, suggesting that these elements might have been destroyed early during the processing sequence to extract marrow and bone grease (Spyrou 2015). This pattern suggests that the inhabitants were conducting highly intensive gazelle processing at the site.

Square AS42 Stratigraphy

A 1 × 1 meter sounding (Square AS42) was excavated during the 2009 and 2010 field seasons to discover the depth of the deposits and the sequence of occupation (FIGURE 3). The upper layers were excavated according to a combination of changes in the nature of the sediments and/or changes in artifact content or density. In the interest of time and

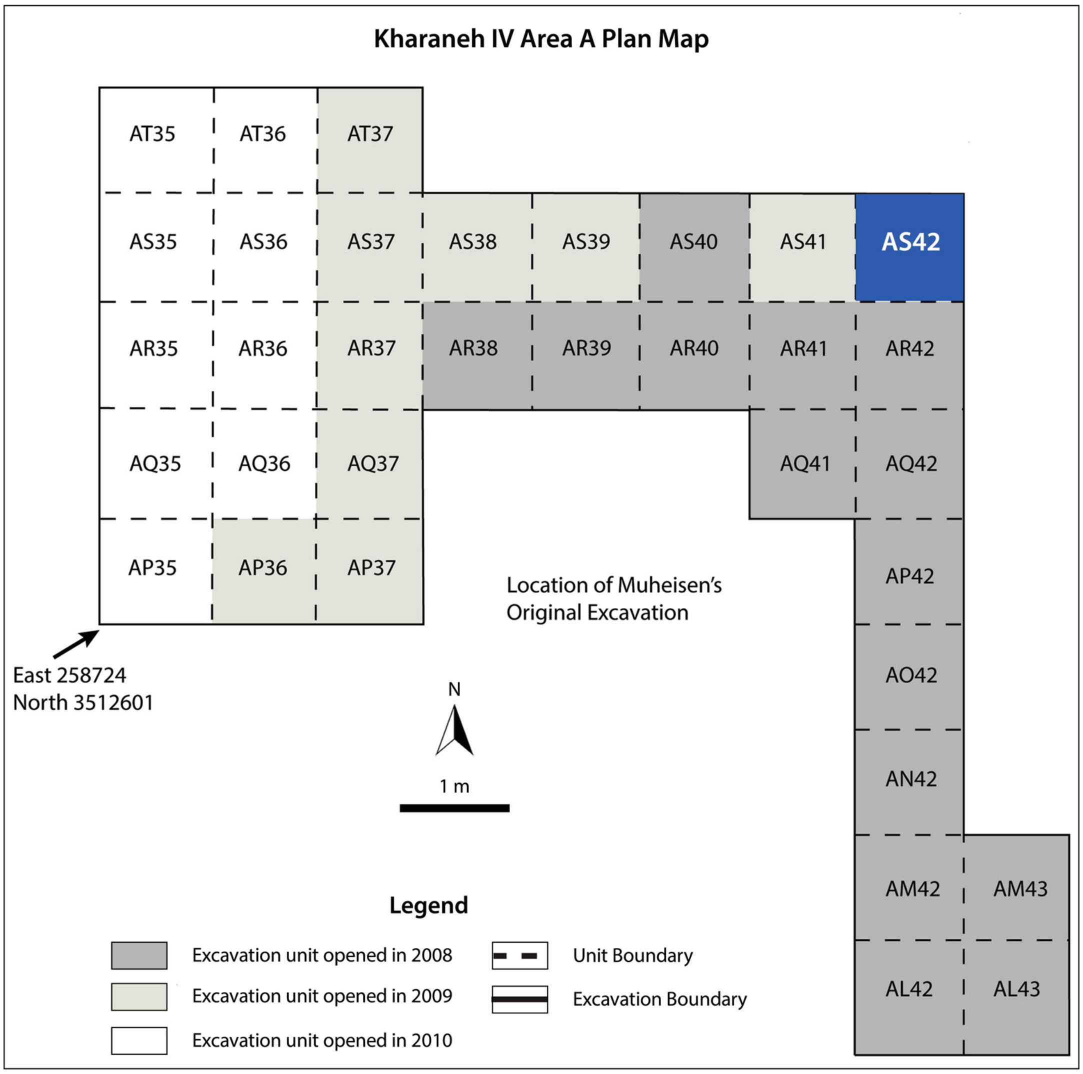

Figure 3. Map of Area A excavation squares. Square AS42 is highlighted in blue.

because of depth of the deposits, we switched strategies to excavate in arbitrary 10 cm levels (at approximately 639.12 masl) to reach sterile deposits. At approximately 638.97 masl, artifact densities began to drop off within a massive, compact, carbonate-rich greenish marl deposit similar to the lake deposits known from another Early Epipalaeolithic site, Ayn Qasiyya, in the Azraq Oasis (Jones and Richter 2011). The excavation strategy was modified again at approximately 638.33 masl, when we stepped in the trench to excavate only the northern half of the square, making a 50 cm × 1 m unit. By decreasing the excavation area, we created a step in the unit allowing us to continue excavations and still escape the deep sounding at the end of the day, while expediting the excavation process. The sounding was approximately 2.3 meters below surface (approx. 637.29 masl) when we stopped excavating because of logistical challenges. Low densities of artifacts and fauna were still being recovered when the unit was closed.

The stratigraphy of AS42 included numerous deposits (FIGURE 4, TABLE 1). The surface of AS42 was covered in a dense pavement of lithics. This highly disturbed deposit was removed as locus 000 at the beginning of the 2009 excavation season. Directly below this surface layer are a series of loose sediments with varying levels of small animal disturbance (loci 001, 002, and 004). These deposits contain dense accumulations of cultural material including lithics and fauna that likely represent refuse accretion resulting from occupation activities. Underlying are deposits characterized by a series of compact occupation surfaces with in situ lithics, faunal remains, worked bone and other cultural material (loci 008, 080, 099, 107, and 115a). On the surfaces of these compact sediments are articulated fauna remains, indicating that these areas are still largely in situ.

Beneath the compact surfaces, at a depth of approximately 638.96 masl (70 cm below ground surface), we uncovered a thin grey clay-rich layer of sediment (locus 115b). On the surface of this deposit was an accumulation of intact bones from large mammals, such as aurochs, equid, and camel. Under this clay was a greenish marly lacustrine deposit enriched in calcium carbonate giving it a white chalky texture (locus 115c), which matches other lacustrine deposits found on-site (in AZ51) and off-site in the surrounding terrace trenches (Jones et al. 2016). The marl is extremely well sorted and compact, with some rust-colored iron staining. We expected this lacustrine deposit to represent the end of the occupational deposits. However, we continued to recover lithics and fauna from within this deposit, albeit in increasingly lower densities. Beneath the marl was a compact brown sediment also with low artifact density (115d), under which was

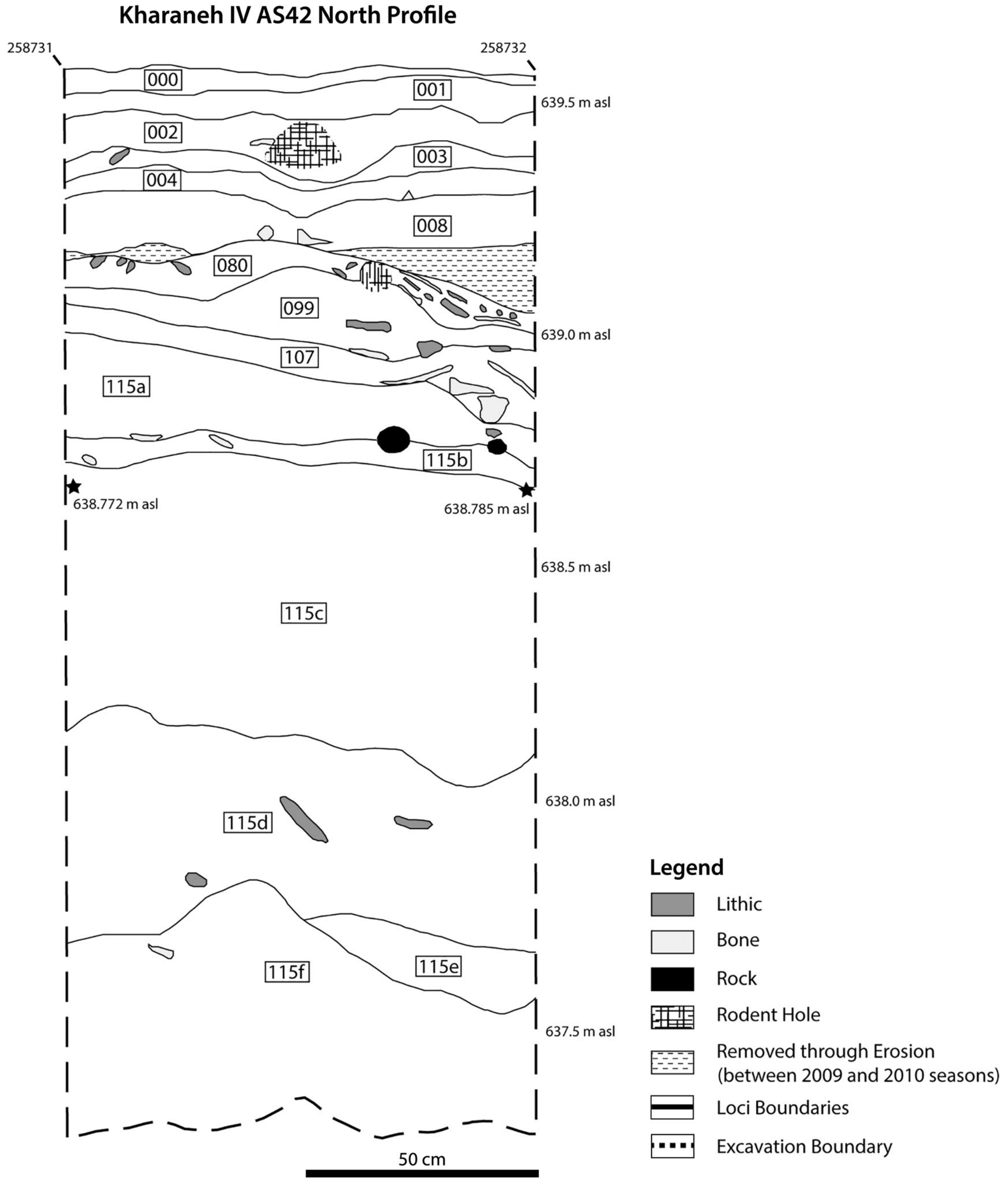

Figure 4. Stratigraphic section for AS42.

another chalky marl lens (115e). The final excavated deposit was a loose brown sediment with a very low artifact density and rust-colored iron stains throughout (115f). We had hoped to reach sterile deposits; yet, small numbers of lithic and faunal artifacts were being recovered from this basal sediment when we stopped excavations.

Methods

Lithic analysis

For the analysis of chipped stone from AS42, lithics from entire the sequence were analyzed. However, due to the extremely high density of artifacts near the surface of the site, only a sample of loci were analyzed from the upper deposits. For this analysis, the surface material (locus 000) and loci 002 and 003 were not analyzed. These deposits are heavily disturbed by rodent activity and thus are not in situ. Locus 001 was analyzed as a representative sample from these upper deposits, and all deposits from 004 and below were analyzed.

The lithic assemblage was divided into categories of microliths, debitage, retouched pieces, cores, and core-trimming elements (CTEs). The debitage analysis for AS42 focused on identifying debitage types, modified from the type list developed for the analysis of blade reduction of Levantine Neolithic naviform cores (Wilke and Quintero 1994). Cores were classified based on their morphology and the targeted removals (e.g., blade, bladelet, and flake). Core-trimming elements (CTEs) were divided into two separate categories: core-preparation and core-maintenance elements. Core-preparation elements are removed during the initial shaping to prepare the core for subsequent removals. These lithics include crested blades, initial platform spalls, and lateral core trimming pieces. In contrast, core-maintenance elements are removed during reduction to maintain the

Table 1. List of deposits from AS42. The transition from assemblages composed of non-geometric microliths to those dominated by geometric microliths happens between loci 115c and 115b.

Locus No.	Bags	Munsell Color	Levels (masl)	Description
000	1	n/a	639.71–639.65	Surface, deflated with very high artifact density. No removal of sediment, only the removal of surface artifacts.
001	2–3	10YR 7/3	639.69–639.57	Disturbed sediment with small-medium sized lithics and bone fragments; compact sandy-loam; sorting 4; roundness 4; pebbles 30%; gradual transition from 000 to 001; disturbances include micromammal/snake burrows.
002	4–5	10YR 6/3	639.61–639.46	Sediment with in situ lithics and large faunal remains; loose sandy-loam; sorting 4; roundness 4; pebbles 30%; gradual transition from 001 to 002; disturbances include micromammal/snake burrows.
003	6	10YR 6/3	639.49–639.44	Thin ashy deposit with a high frequency of charcoal and small fragmented artifacts; compact sandy-loam; sorting 4; roundness 4; pebbles 30%; clear transition from 002 to 003; disturbances include micromammal/snake burrows.
004	7–8	10YR 6/3	639.46–639.27	Loose sandy-loam sediment with a high artifact density; sorting 4; roundness 5; pebbles 40%; gradual transition from 003 to 004; disturbances include micromammal/snake burrows
008	9–11	10YR 6/3	639.33–639.24	Gray compact sediment with a high density of charcoal fragments; sorting 3; roundness 3; pebbles 30%; clear transition from 004 to 008; disturbances include micromammal/snake burrows
080	12		639.24	Compact sediment initially exposed at beginning of 2010 field season, partially disturbed; sandy-loam; other soil properties not collected.
099	13–14		639.34–639.13	Compact sediment with highly fragmented faunal remains; sandy-loam; sorting 3; roundness 4; pebbles 30%; diffuse transition from 080 to 099
107	15–17		639.21–639.03	Compact sediment with large faunal remains; silty-loam; sorting 3; roundness 3; pebbles 30%; clear transition from 099 to 107; disturbances include micromammal/snake burrows.
115a	18–19	10YR 6/3	639.12–638.90	Light yellowish-brown sediment with large concentrations of faunal remains; compact silty-loam.
115b	21	10YR 6/3, 10YR 8/1	638.97-638.81	Brown sediment (115a) mixed with gray clay beneath; silty-clay; large faunal remains on top of gray.
115c	22–32	5YR 8/1	638.86–637.97	Compact-to-hard white marl with low to average artifact density; some rust-colored iron stains; silty-clay; sorting 5; pebbles 0%; sharp transition between 115b and 115c.
115d	33–34		637.99–637.71	Compact brown sediment with low artifact density; sharp transition between 115c and 115d.
115e	35	5YR 8/1, 10YR 8/2	637.79-637.63	White marl lens mixed with brown sediment (115f) beneath; rust-colored iron stains; sharp transition between 115d and 115e.
155f	36–38	10YR 8/2	637.69–637.29	Loose brown sediment with low artifact density; rust colored iron stains; sharp transition between 115e and 115f.

core shape. These elements manipulate the platform or correct issues on the core face so that removals can continue. Platform maintenance elements include angle correction elements and core tablets. Elements specifically targeting issues on the core face include core face rejuvenation elements and partially crested blades.

Non-microlithic retouched tools were classified according to Epipalaeolithic typologies developed by Bar-Yosef (1970) and Goring-Morris (1987) for the Southern Levant, typologies that are widely used for this period. The former typology focuses more generally on Epipalaeolithic assemblages from Israel/Palestine, while the latter was developed specifically for sites in the Negev and Sinai. A combination of typological and attribute analysis was employed for the analysis of the tools.

As with the retouched tools, typologies developed by Bar-Yosef (1970) and Goring-Morris (1987) were used to classify the microlith tool types. Typological lists created by Muheisen (Muheisen and Wada 1995) and designed for Kharaneh IV were also consulted. To begin the analysis, the microliths were divided into geometrics, non-geometric, and fragmentary microliths. Geometric microliths are defined as microlithic artifacts retouched into a geometric shape, often trapezoidal or rectangular forms. Non-geometric microliths are retouched bladelets without a geometric form and tend to be less extensively retouched than geometrics. Often in typological analysis, fragmentary microliths such as medial bladelet sections are classified as non-geometrics, which inflates the percentages of non-geometrics in assemblages. For example, in Bar-Yosef's typology (1970) medial sections are classified as "broken backed bladelets" along with proximal and distal fragments of non-geometrics. As well, medial sections are classified in the non-geometric microlith category of "retouched/backed bladelet fragments" in Goring-Morris' Epipalaeolithic typology (1987). For this analysis, the category "fragmentary microliths" was created to avoid misclassification and to remove the bias of incorrectly classifying microliths as either geometrics or non-geometrics. Medial backed bladelet sections (i.e., bladelets with two broken ends) were automatically classified as fragmentary microliths. In addition, broken microliths with backing or oblique truncations were often classified as fragmentary microliths if the original tool type was ambiguous. However, if possible, broken microliths were identified to a more specific tool type based on morphology of the broken piece. From these three overarching categories of non-geometric, geometric, and fragmentary microliths, the microliths were further subdivided into types based on the typologies developed by Bar-Yosef (1970) and Goring-Morris (1987).

Faunal analysis

Faunal material was divided into identifiable and unidentifiable categories that determined subsequent analysis. The term "identifiable" denotes that a faunal specimen has been identified to a taxonomic order or lower (Lyman 2008: 27). Unidentified specimens were classified to a taxonomic class (e.g., Mammalia) and, if possible, to a live animal size category (e.g., medium), but not further scrutinized. Identifiable specimens were recorded according to a limited set of analytical categories, such as taxon, anatomical region and element, element portion, element completeness, symmetry, and state of epiphyseal fusion. Butchery, modification, burning, and pathology were also noted.

Specimens were quantified by a simple, additive measure of taxonomic abundance, Number of Identified Specimens (NISP), that, while sensitive to the effects of specimen interdependence, is not subject to the more severe effects of sample aggregation. Bone fragments that could not be assigned to a particular skeletal element were excluded from NISP tallies. As examples, mammal ribs and vertebrae, and tortoise shell scutes were commonly encountered bone specimen types that, while in some cases could be identified to a low taxon by virtue of unique biological structures, could not be assigned to a specific skeletal element. Upholding these inclusion criteria for NISP for all taxa is important for ensuring inter-taxonomic comparability. However, exclusivity has a suppressive effect on some taxa in the sample, such as tortoise and ostrich. Tortoise carapace and plastron elements are readily identified as to species, but not to a particular element in the skeleton. Likewise, small bone fragments from very large birds are certainly from ostrich, but cannot be identified as to skeletal element in most cases.

Derived measures of taxonomic abundance that attempt to estimate the minimum number of animals required to account for a given taxon (i.e., Minimum Number of Individuals [MNI]) were not attempted given expected sample aggregation effects for the deeply stratified AS42 sounding.

Results

Detailed analysis of the lithic artifacts recovered from square AS42, as well as analysis of the faunal assemblage, highlight some interesting patterns and changes in occupation at Kharaneh IV. Evaluating the density of lithics throughout the sequence of AS42, we see an increase in artifact density over time, starting at loci 115b (FIGURE 5). This sudden increase correlates with the end of the lake deposits. This could suggest an increase in occupation intensity towards the end of the site's occupation, however it could also reflect the inhabitants of Kharaneh IV moving to new locations on the site (with more intensive occupation at the location of AS42 towards the end of the site's occupation).

As well, there is a clear shift from the manufacture of non-geometric to geometric microliths over time (FIGURE 6). The proportion of non-geometrics to geometrics shifts at the transition from locus 155b to 115c, which is the boundary of the lake deposits and when lithic densities become notably greater. In the deposits above the white marls (locus 115c), the microlith assemblage is dominated by geometric microliths. When the density of lithics drops at locus 115c, the microliths assemblage switches to become dominated by non-geometric microliths. This transition from geometric to non-geometric microliths happens right at the top of the lake deposits, suggesting at least two different discrete phases of occupations at this area of the site, an Early Epipalaeolithic phase and a Middle Epipalaeolithic phase. These two assemblages are analyzed as two separate cultural entities in the section below.

Early Epipalaeolithic lithics

The earliest evidence of occupation in AS42 (loci 115c, 115d, 115e, and 115f) is characterized by a low density of lithics and a microlith assemblage primarily composed of non-geometric microliths. Although the lithic assemblage from these lower deposits in AS42 is relatively small for Kharaneh IV (n = 8441 lithics), the full knapping sequence of the chaîne opératoire is represented including flake and blade debitage, core trimming elements, and cores (TABLE 2). The cores include both broad-faced (n = 36) and narrow-faced types (n = 56), used to produce blanks for microliths. Both these core types have evidence of bladelets as final removals from the cores. Other core types include sub-pyramidal cores (n = 1), flakes cores (n = 15), opposed platform cores (n = 11), change of orientation cores (n = 11), multidirectional cores (n = 20), and core fragments (n = 16). Narrow-faced cores are the prominent core type in the assemblage (33.7%), as is typical for Early Epipalaeolithic assemblages. These cores were used to produce regular and standardized gracile bladelets as microlith blanks.

Core trimming elements include both core preparation and core maintenance types. Core preparation pieces includes initial faceted platform spalls (n = 15), crested blades (n = 8), and lateral core trimming pieces (n = 37). Core maintenance is evidenced through the presence of non-initial core tablets (n = 59), initial core tablets (n = 11), profile correction blades (n = 78), partially ridged blades (n = 16), core face rejuvenation flakes (n = 80), and angle correction elements (n = 40).

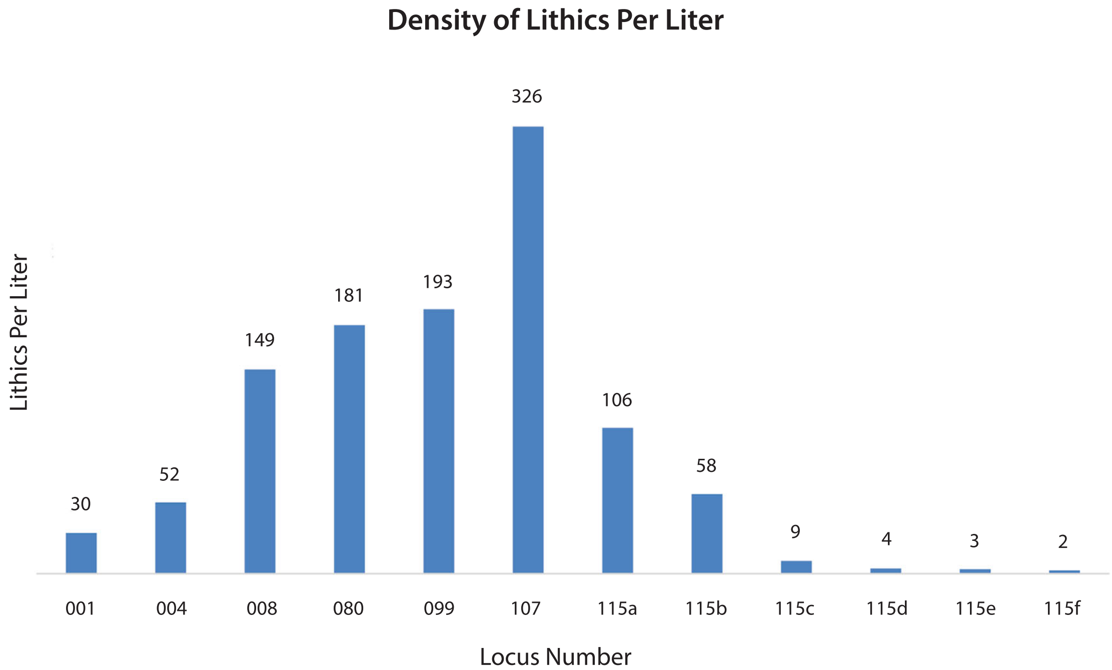

Figure 5. Density of lithics per liter in each stratigraphic unit (loci). The highest (latest) deposit is on the left, moving right towards the lowest (earliest) deposit.

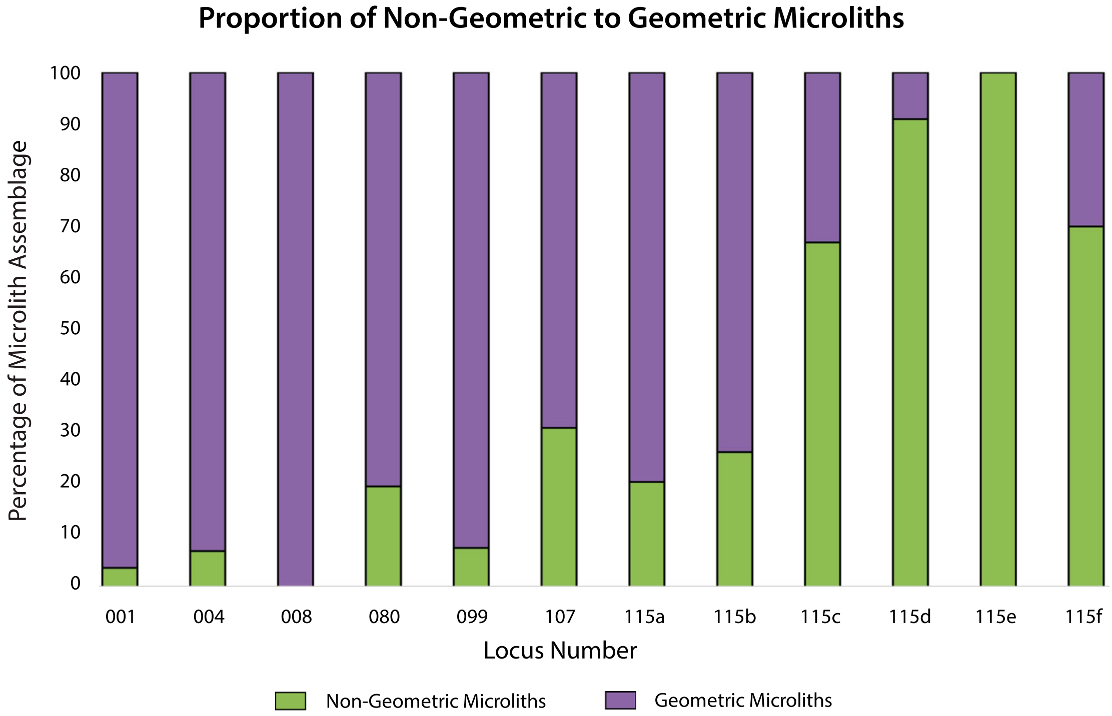

Figure 6. Proportion of non-geometric to geometric microliths across stratigraphic units. The highest (latest) deposit is on the left, moving right towards the lowest (earliest) deposit.

Of the core trimming assemblage, 17.4% is represented by core preparation flakes (n = 60), while 82.6% is represented by core maintenance (n = 284). The debitage assemblage includes flakes, blades, primary pieces, chips and shatter. The flake to blade ratio is 1.82, indicating that flakes occur almost twice as frequently as blades. This is higher than other Epipalaeolithic assemblages, which tend to have a higher proportion of blades in the debitage (Henry 1995). There are also primary pieces in the assemblage, pieces with 100% cortical dorsal surface, representing 2.4% of the flake/blade assemblage. Although this is a low proportion, it suggestions that some initial flintknapping was taking place in this area of the site.

Overall, microliths represent 46.2% of the lithic assemblage. From these Early Epipalaeolithic deposits only 244 microliths were recovered (TABLE 3). These are dominated by non-geometric microliths at 41% of the microlith assemblage. The assemblage contains a range of different microlith types, most frequently completely or partially backed bladelets, obliquely truncated bladelets, pointed backed bladelets, and microgravettes (FIGURE 7). Two of the pointed backed bladelets are large and resemble Falita points with backing along one edge, although lack the characteristic retouch on the other margin of the point. The microliths are retouched using abrupt, and sometimes bipolar retouch, suggesting that the backed bladelets and the pointed backed bladelets might represent early stages in the chaîne opératoire towards making microgravette tools. Obliquely-truncated microliths are more common towards the top of the Early Epipalaeolithic sequence (locus 115c), disappearing in locus 115d. These tools are replaced by microgravettes (which also appear in locus 155c), pointed and backed bladelets, and scalene bladelets. A single triangle was found in locus 115d. This change in microlith typology suggest a possible shift in Early Epipalaeolithic groups at the site, with an early occupation represented by people making scalene bladelets, and microgravettes, and a later occupation focusing on obliquely truncated bladelets. It should also be noted that the majority of the geometric microliths are found in the upper Early Epipalaeolithic deposit 115c, suggesting there might be mixed deposits from the Middle Epipalaeolithic layers above. The non-geometric microlithic tool assemblage from locus 115c focused on the production of oblique truncated microliths is more closely aligned to the Early Epipalaeolithic occupation found in Area B (Maher and Macdonald 2013), suggesting that this occupation spread across a large area of the site.

The macrolithic retouched tools are dominated by end-scrapers on blades, retouched flakes and blades, and multiple tools on large blades (TABLE 4). These tools are typical for the Early Epipalaeolithic and suggest that the early inhabitants of Kharaneh IV were engaged in a wide range of craft activities at the site. Use-wear analysis conducted on Early Epipalaeolithic tools from Area B show a range of hide working and butchering tasks undertaken at the site, and these Early Epipalaeolithic tools may have been used for similar purposes (Macdonald and Maher in press).

The Early Epipalaeolithic lithic assemblage is also characterized by the use of the microburin technique, with a total of 30 recovered microburins. Although there are a few microburins recovered from the Middle Epipalaeolithic deposits

Table 2. Lithic assemblage from Early Epipalaeolithic deposits (loci 115c–115f).

Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Tools			439	5.2%
Microburins			30	0.4%
Burin Spalls			11	0.1%
Debitage			7451	88.3%
	Flakes	2910		
	Blades	1602		
	Primary Pieces	112		
	Chips and Shatter	2827		
CTE			344	4.1%
	Core Preparation	60		
	Core Maintenance	284		
Cores			166	2.0%
Total			8441	100.0%

Table 3. Early Epipalaeolithic microlith types from AS42 (loci 115c–115f).

Microlith Type	Locus Number 115c	115d	115e	115f	Total #	Percent
trapeze-rectangle	18	0	0	1	19	7.79
unbacked trapeze	14	0	0	2	16	6.56
asymmetrical trapeze A	2	0	0	0	2	0.82
asymmetrical trapeze B	2	0	0	0	2	0.82
trapeze-rectangle with one pointed end	1	0	0	0	1	0.41
triangle	0	1	0	0	1	0.41
lunate	1	0	0	0	1	0.41
other	3	0	0	0	3	1.23
microgravette	3	1	0	3	7	2.87
completely backed bladelet	20	0	0	0	20	8.20
obliquely truncated and backed bladelet	5	0	0	0	5	2.05
obliquely truncated bladelet	22	1	0	1	24	9.84
pointed and backed bladelet	7	1	0	2	10	4.10
partially backed bladelet	22	3	0	0	25	10.25
pointed and retouched on both sides	1	0	0	0	1	0.41
arched backed bladelet	2	0	1	0	3	1.23
scalene bladelet	1	4	0	1	6	2.46
fragmentary microliths	92	2	3	1	98	40.16
Total	216	13	4	11	244	100.00

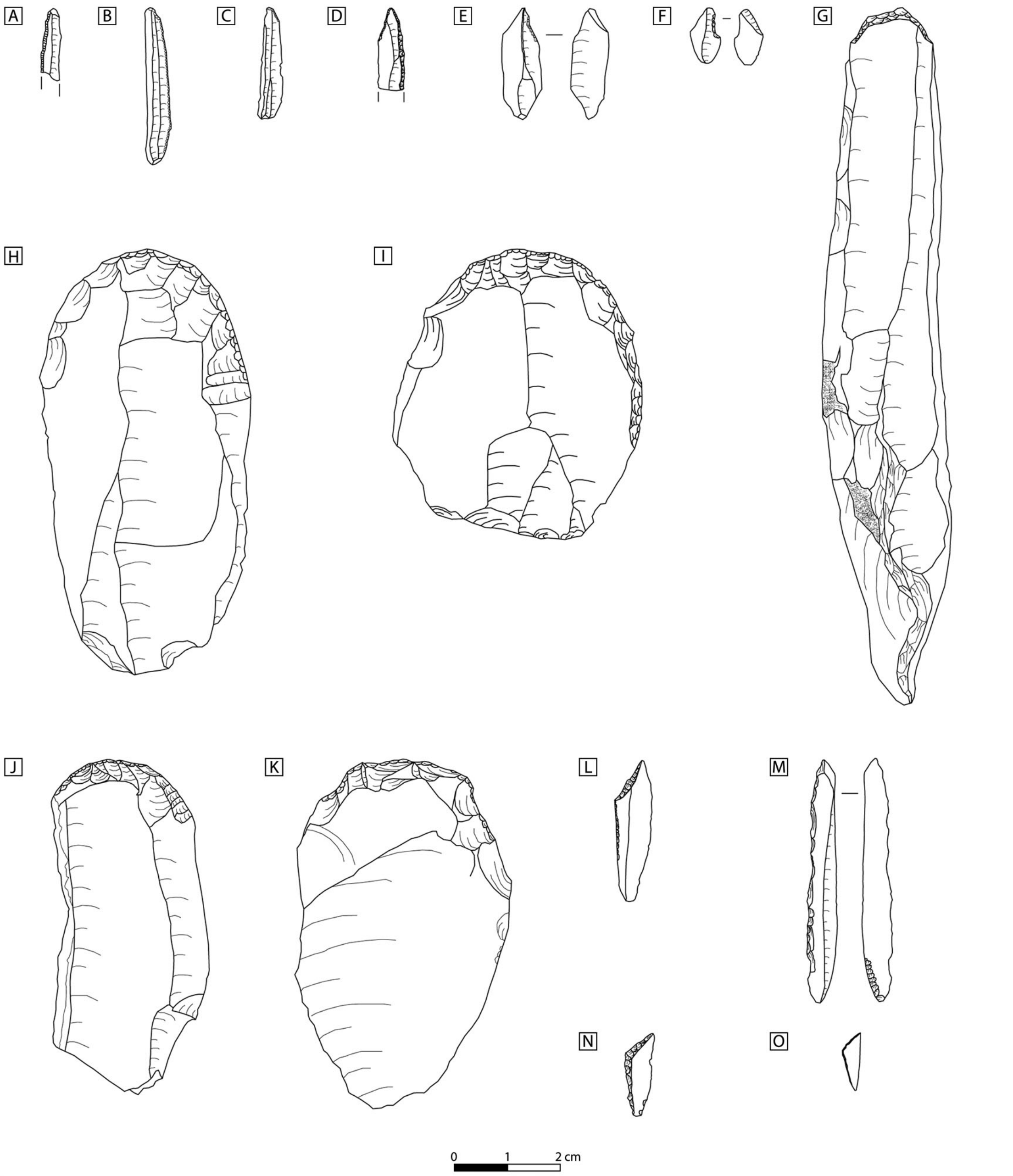

Figure 7. Early Epipalaeolithic microliths. Locus 115c: A) backed bladelet; B) completely backed bladelet; C) obliquely truncated bladelet; D) microgravette; E) microburin; F) microburin; G) endscraper on a core trimming element; H) endscraper on a blade; I) endscraper on a flake. Locus 115d: J) endscraper on a blade; K) endscraper on a core tablet; L) obliquely truncated bladelet; M) microgravette; N) scalene bladelet. Locus 115f: O) scalene bladelet.

Table 4. Early Epipalaeolithic tool assemblage from AS42 (loci 115c–115f).

Tool Type	Count	Percent
Non-Geometric Microliths	101	23.0%
Geometric Microliths	45	10.3%
Fragmentary Microliths	98	22.3%
Scrapers	69	15.7%
Multiple Tools	20	4.6%
Burins	15	3.4%
Retouched Burin Spall	1	0.2%
Retouched Pieces	49	11.2%
Backed Blades	25	5.7%
Truncations	1	0.2%
Perforators	1	0.2%
Notches and Denticulates	10	2.3%
Pieces Esquille	1	0.2%
Heavy Duty Tools	3	0.7%
Total	439	100.0%

(locus 008, n = 1; locus 099, n = 3), the presence of microburins notably increases in locus 115c, with 22 microburins recovered. The remaining eight microburins were found in the final three deposits (loci 115d, 155e, and 115f). The presence of these microburins suggests that this specialized technique of bladelet snapping was known and used, however, the restricted microburin index (*rIMbt* = 17.05), is well below the threshold of 50 that Henry (1974) suggests is necessary to show the habitual use of the technique (FIGURE 8). Thus, it is likely that although some of the microliths were snapped using this technique, others were produced using different snapping methods. Furthermore, because the microlith technology in these deposits is primarily focused on the production of non-geometric microliths that did not require snapping, the microburin technique would have only been used for select microlith production. Although we have not identified clear microburin scars on microliths from these deposits, this snapping technique might have been used for obliquely truncated bladelets, where the microburin scar would be obscured by the subsequent retouch.

In addition to the chipped stone assemblage, other types of material culture were recovered from the Early Epipalaeolithic occupational deposits of AS42. A single basalt pestle fragment was found at the top locus 115c, indicating that grinding activities were taking place. Further down in 115c, a few small fragments of unidentifiable basalt groundstone were recovered. As well, a shell bead was recovered from this locus.

Early Epipalaeolithic fauna

The Early Epipalaeolithic faunal sample comprises 586 identified specimens (TABLE 5). This sample contains an additional 8115 unidentified bone fragments. This low rate of identification (7%) is a product of the highly fragmentary nature of the sample, which may owe its condition to the sedimentary environment in which it was deposited. Gazelle is the most common taxon in the sample, accounting for 81.1% of all identified animal remains. Other small ungulates that are occasionally recovered from Pleistocene sites in eastern Jordan, such as goat or sheep, are not encountered in this sample. The only other bovid represented in the Early

$$\frac{30}{146+30} \times 100 = rlMbt\ 17.05$$

Figure 8. Restricted microburin index for Early Epipalaeolithic assemblage.

Epipalaeolithic sample is aurochs (2.2%). Two other ungulates in this sample are boar (0.2%) and Equidae (9.0%). The collection of equids at hand did not provide an opportunity to define the species. Medium-sized carnivores are exclusively represented by the genus Canis (0.2%), which include dogs, wolves, and jackals. Fast small game include fox (3.8%), hare (2.7%), and goose (0.2%). Slow small game is solely represented by tortoise (0.2%). A sum of 65 ostrich bone fragments from the Early Epipalaeolithic deposits are interdependent because all of them derive from the same locus and 55 of these specimens are fragments identified only by virtue of a unique, low-density trabecular structure possessed only by an ostrich-sized bird.

Middle Epipalaeolithic lithics

Overall, the lithic assemblage from the Middle Epipalaeolithic levels of AS42 is much larger than the lower levels, with 85,834 lithics analyzed (note that loci 002 and 003 from the Middle Epipalaeolithic layers were not analyzed, thus the count would be even higher if the complete assemblage was included). A complete chaîne opératoire for the knapping process is evidenced in the lithic assemblage with the presence of cores, core-trimming elements, debitage, and tools (TABLE 6). However, the technological strategy is significantly different between the Early and Middle Epipalaeolithic levels in AS42. Unlike the Early Epipalaeolithic levels, there is very little evidence for the use of the microburin technique in the Middle Epipalaeolithic, with only 3 microburins recovered from the deposits. Other changes in technology include the switch from using narrow-faced cores to using broad-faced cores. In the Middle Epipalaeolithic assemblage, 40.2% (n = 82) of the cores are broad-faced, while only 22.5% (n = 46) are narrow-faced. The change from a focus on narrow-faced cores to broad-faced cores is characterized by raw material selection; during the Early Epipalaeolithic the inhabitants of Kharaneh IV are preferentially choose narrow-faced cobbles found within the vicinity of the site. By the Middle Epipalaeolithic, they have shifted to a wider range of core shapes and sizes, as well as choose some material that is located further from the site in addition to more local sources (Christophe Delage, Javier M. Llach, and Manuel Torres, personal communication 2018). The differential choice in raw material reflects the shift from making narrow, gracile, bladelets to making a wider range of bladelet (and even flake) shapes to be used as blanks for more invasively retouched geometric microliths. Other core types represented in the Middle Epipalaeolithic assemblage of AS42 include sub-pyramidal cores (n = 8), flake cores (n = 5), opposed platform cores (n = 7), change of orientation cores (n = 25), multidirectional cores (n = 3), and core fragments (n = 28). The flake to blade ratio is 1.39, which the lower than the Early Epipalaeolithic assemblage, suggesting that this assemblage is more focused on blade production. Within the debitage, there are 689 primary pieces of debitage. The presence of these pieces suggests that some primary reduction was taking place in this area, although these pieces represent a very small percentage of the flakes/blades (1.5%).

Core trimming elements include both core preparation and core maintenance types. Core preparation types include initial faceted platform spalls (n = 46), crested blades (n = 58), and lateral core trimming pieces (n = 216). Core maintenance is evidenced through the presence of non-initial core tablets (n

Table 5. Early Epipalaeolithic taxonomic frequencies (NISP) from AS42. * indicates specimens that are identified as to species, but which do not meet the inclusion criteria for NISP because they cannot be identified to a specific skeletal element.

		Locus Number				Total	
Taxon	Common name	115c	115d	115e	115f	n	%NISP
Ungulates							
Gazella subgutturosa	gazelle	436	28	3	8	475	81.1
Bos primigenius	aurochs	12	1			13	2.2
Sus scrofa	boar	1				1	0.2
Equus sp.	equid	52			1	53	9.0
Medium Carnivores							
Canis sp.	dog/wolf/jackal	1				1	0.2
Carnivora medium	medium carnivore	2				2	0.3
Small Game							
Vulpes vulpes	red fox	22				22	3.8
Carnivora small	small carnivore	1				1	0.2
Lepus sp.	hare	16				16	2.7
Birds							
Anser sp.	goose	1				1	0.2
Reptiles							
Testudo graeca	spur-thighed tortoise	1				1	0.2
Unidentified							
Mammalia large	large mammal	149	10	1	7	167	
Mammalia med.	medium mammal	259	36	3	4	302	
Mammalia small	small mammal	5				5	
Mammalia	mammal	6714	311	25	120	7170	
*Struthio camelus**	ostrich	65				65	
Aves med.	medium bird	1				1	
Aves small	small bird	1				1	
Aves	bird						
*Testudo graeca**	spur-thighed tortoise	379	17	1	7	404	
Total ID		617	30	4	10	661	100.0
Total UnID		7129	357	29	131	7646	
Total (ID + unID)		8118	386	32	140	8701	

= 212), initial core tablets (n = 18), profile correction blades (n = 438), partially ridged blades (n = 257), core face rejuvenation flakes (n = 378), angle correction elements (n = 196), and bottom partially ridged blades (n = 8). Of the core trimming element assemblage, 17.5% is represented by core preparation flakes (n = 320), while 82.5% is represented by core maintenance (n = 1507). The proportion of core preparation to core maintenance flakes is very similar between the Early and Middle Epipalaeolithic assemblage in AS42. This is in contrast to analysis of the Early Epipalaeolithic assemblages from Area B, which showed a much higher percentage of core preparation flakes (Maher and Macdonald 2013).

Like the Early Epipalaeolithic lithic assemblage from AS42, the Middle Epipalaeolithic assemblage is dominated by microliths, which represent 78.5% of the tool assemblage (FIGURE 9). However, in contrast to the Early Epipalaeolithic loci, the Middle Epipalaeolithic microlith assemblage is primarily composed of geometric microliths (TABLE 7). As well, the lithic density is much higher than during the Early Epipalaeolithic, in total 2132 microliths were recovered from these loci (000–004, 008, 080, 099, 107, and 155a–b) (FIGURE 9). The most frequent type of geometric microliths are unbacked trapezes (n = 398), followed by trapeze rectangles (n = 286). Because broken unbacked trapezes can look identical to oblique truncations, which are also found in the assemblage, pieces that were broken were classified as fragmentary, making this the largest overall category of microlith (n = 1146). Despite this conservative approach to classifying microliths, the geometric microliths are represented in much higher frequencies than non-geometric microliths with the geometrics at 36.8% of the microlith assemblage, while non-geometrics represent 6.0% of the microliths (microliths classified as fragmentary compose the remaining 57.2%). There is also more diversity in the types of microliths present in the Middle Epipalaeolithic lithic assemblage then in the Early Epipalaeolithic levels of AS42. In total, there are eight different types of geometric microliths and ten different types of non-geometric microliths in the assemblage. Some of the different geometric forms include asymmetrical trapeze B (n = 11), triangles (n = 3), lunates (n = 7), and a parallelogram (n = 1). Some of this diversity may relate to the larger sample size, however a similar trend was noted when comparing Early and Middle Epipalaeolithic phases across the site (Maher and Macdonald 2013) and we suggest that the wide diversity of different geometric forms may also relate to different social groups, with differing traditions of preferred microlith form, aggregating at the site.

Table 6. Lithic assemblage from Middle Epipalaeolithic deposits (loci 000-004, 008, 080, 099, 107, and 115a-b).

Lithic Class	Lithic Sub-class	Sub-count	Count	Percent
Tools			2680	3.1%
Microburins			4	0.0%
Burin Spalls			98	0.1%
Debitage			81021	94.4%
	Flakes	27360		
	Blades	19664		
	Primary Pieces	689		
	Chips and Shatter	33308		
CTE			1827	2.1%
	Core Preparation	320		
	Core Maintenance	1507		
Cores			204	0.2%
Total			85834	100.0%

Like the Early Epipalaeolithic levels of AS42, the Middle Epipalaeolithic levels contain a wide range of tools (TABLE 8), dominated by retouched flakes/blades (n = 186) and endscrapers (n = 65). Other frequent tool types include backed blades (n = 51), multiple tools (n = 28), burins (n = 28), and notches and denticulates (n = 27). These tool types are typical for Middle Epipalaeolithic assemblages and the diversity reinforces that a wide range of craft activities were also undertaken here during the Middle Epipalaeolithic use

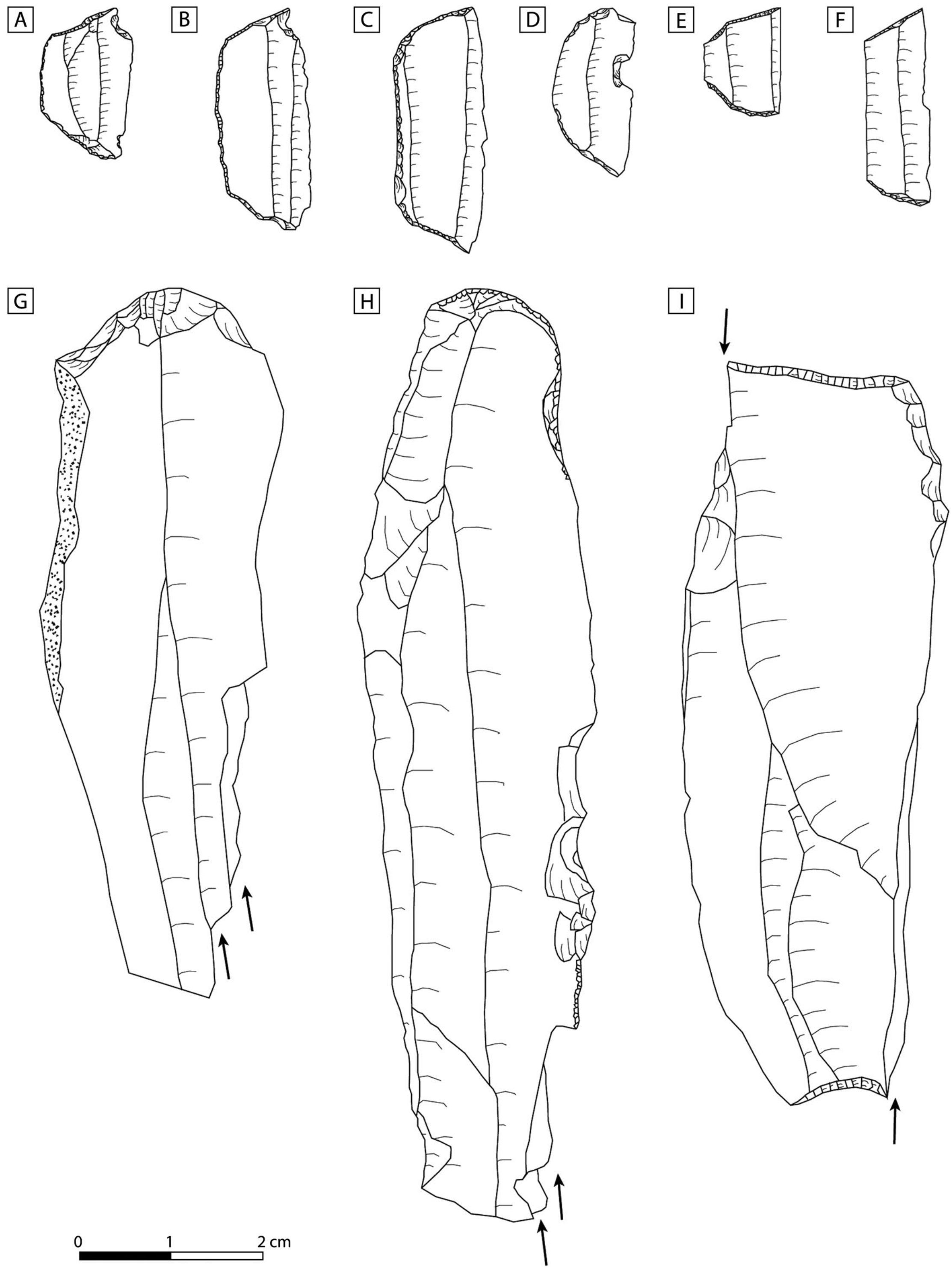

Figure 9. Middle Epipalaeolithic microliths. Locus 107; A–C) trapeze-rectangles; D) lunate; E–F) unbacked trapezes; G) multiple tool (endscraper on a burin); H) multiple tool (endscraper on a burin); I) multiple tool (burin on straight truncation, burin on concave truncation).

of the site. In addition to the chipped stone assemblage, three ground basalt fragments were found in locus 115b, suggesting that grinding and other processing activities were taking place.

Middle Epipalaeolithic fauna

The Middle Epipalaeolithic sample includes 1560 bone and tooth specimens, of which 762 are taxonomically identified (TABLE 9). This sample is more taxonomically rich than the Early Epipalaeolithic sample. The Middle Epipalaeolithic sample has 13 genera, whereas the Early Epipalaeolithic sample has 9 genera. This difference does not appear to be motivated by sample size, as both samples are comparable in size. As they are in the Early Epipalaeolithic sample, gazelle remains are more common than any other taxon in the Middle Epipalaeolithic levels (78.3% of NISP). At least one other small ungulate, sheep or goat, is represented by single bone finds in two loci (loci 001 and 115b). Aurochs accounts for a modest fraction (2.8%) of the assemblage. A single 3rd phalanx is the only evidence for boar. The most abundant large ungulate taxon, *Equus* sp., is ranked second in abundance (12.5%). The presence of one other large ungulate, the dromedary camel, is evident from a single specimen, a

Table 7. Middle Epipalaeolithic microlith types from AS42 (loci 000-004, 008, 080, 099, 107, and 115a-b). Percent reflects percentage of the total assemblage of microliths.

	Locus Number									
Microlith Type	001	004	008	080	099	107	115a	115b	Total #	Percent
trapeze-rectangle	30	13	32	32	90	38	31	20	286	14.27
unbacked trapeze	20	13	0	53	191	50	61	10	398	19.86
asymmetrical trapeze A	0	0	0	1	0	1	0	0	2	0.10
asymmetrical trapeze B	0	0	0	0	7	1	3	0	11	0.55
trapeze-rectangle with one pointed end	3	0	10	2	5	3	3	1	27	1.35
triangle	0	0	2	1	0	0	0	0	3	0.15
lunate	0	1	1	2	2	1	0	0	7	0.35
parallelogram	0	0	0	0	1	0	0	0	1	0.05
other	0	0	0	0	1	0	0	1	2	0.10
microgravette	0	0	0	1	0	0	0	0	1	0.05
completely backed bladelet	0	0	0	0	0	20	0	0	20	1.00
obliquely truncated and backed bladelet	0	0	0	0	1	4	2	0	7	0.35
obliquely truncated bladelet	1	1	0	6	11	7	9	6	41	2.05
micropoint	0	1	0	0	0	0	0	0	1	0.05
curved bladelet	0	0	0	0	0	0	0	4	4	0.20
pointed bladelet	1	0	0	0	3	2	2	0	8	0.40
partially backed bladelet	0	0	0	13	9	9	5	1	36	1.85
pointed and retouched on both sides	0	0	0	2	0	0	0	0	2	0.10
fragmentary microliths	98	37	90	168	383	192	189	86	1146	57.19
Total	153	66	135	281	704	328	305	129	2004	100.00

complete 1st phalanx. Four specimens from locus 115b comprise the small collection of remains from *Canis* sp., which is the only medium-sized carnivore recorded in the sample. The fast small prey include fox (1.7%), hare (2.6%), an unidentified species of weasel (0.1%), bustard (0.1%), sandgrouse (0.1%), and goose (0.1%). Slow small game is exclusively represented by tortoise (0.3%).

Diachronic continuity and change of taxonomic abundance between the two periods is the critical issue at hand (TABLE 10). Difference of proportions tests are used here to gauge taxonomic frequency changes between the Early and Middle Epipalaeolithic periods. The results show that relative frequencies of gazelle, aurochs and hare did not change markedly between the two periods ($p > 0.05$). The modest but consistent presence of aurochsen in the Early Middle Epipalaeolithic phases represents proxy evidence for standing water in both periods, as cattle require access to drinking water at least every second day (Uerpmann 1987: 72). Two animal taxa, however, show a marked frequency change between the two periods. A noted increase of 3.5% in equid relative abundance in the Middle Epipalaeolithic sample compared to the Early Epipalaeolithic sample is significant ($z = -2.05$, $p = 0.04$) and the 2.1% decrease in the relative proportion of fox in the Middle Epipalaeolithic sample compared to the Early Epipalaeolithic sample is also significant ($z = 2.32$, $p = 0.02$). These results indicate that equid and fox are marked by diachronic differences in relative taxonomic abundance.

Table 8. Middle Epipalaeolithic tool assemblage from AS42 (loci 000-004, 008, 080, 099, 107, and 115a-b).

Tool Type	Count	Percent
Non-Geometric Microliths	121	4.7%
Geometric Microliths	737	28.9%
Fragmentary Microliths	1146	44.9%
Scrapers	65	2.5%
Multiple Tools	28	1.1%
Burins	28	1.1%
Retouched Burin Spalls	3	0.1%
Retouched Pieces	186	7.3%
Backed Blades	51	2.0%
Truncations	16	0.6%
Notches and Denticulates	27	1.1%
Perforators	2	0.1%
Varia	8	0.3%
Pieces Esquille	1	0.0%
Utilized Pieces	129	5.1%
Heavy Duty Tools	4	0.2%
Total	2552	100.0%

These results, although tenuous, provide some insight about the impact of environmental conditions on wildlife. Geomorphological evidence demonstrates that a wetland was adjacent to Kharaneh IV during the Early Epipalaeolithic and that it began its eastward retreat during the Middle Epipalaeolithic (Jones et al. 2016). The sustained presence of aurochs and the increase of equids during this so-called "drying-out" phase, however, suggests that the ecological impact on large ungulates was not obviously felt. Furthermore, remains of both waterfowl, represented by goose, and steppic taxa, such as bustard and sandgrouse, testify to the fact that the Middle Epipalaeolithic environmental conditions in the vicinity of Kharaneh IV were sufficiently variegated as to accommodate animals with a diversity of ecological requirements. Given that lithic densities are markedly higher in the Middle Epipalaeolithic deposits, a greater emphasis on large prey, which include aurochs, equid, board, camel and ostrich, during this period may relate to increased occupation intensity in the context of humid environmental conditions that sustained this biodiversity. The decline of fox relative abundance in the Middle Epipalaeolithic is rather more challenging to reconcile with the new environmental regime of the period, as foxes would have thrived on a variegated landscape and human refuse (Mendelssohn and Yom-Tov 1999). Accordingly, foxes would be expected to rise in relative abundance during periods of peak occupation intensity, yet their remains moderately declined in the Middle Epipalaeolithic. An analysis of fox remains from Late Epipalaeolithic deposits from sites around Mt. Carmel by Yeshurun and colleagues (Yeshurun et al. 2009) found a pattern in line with that from AS42: fox abundance increased as human occupation decreased between the Early and Late Natufian periods. Unfortunately, the data from AS42 are not sufficiently robust to make sense of this complex issue that requires an understanding of the taphonomic and demographic condition of the fox assemblage.

Table 9. Middle Epipalaeolithic taxonomic frequencies (NISP) from AS42. *indicates specimens are identified as to species, but which do not meet the inclusion criteria for NISP because they cannot be identified to a specific skeletal element.

		Locus Number						Total	
Taxon	Common name	001	004	080	099	107	115b	n	%NISP
Ungulates									
Gazella subgutturosa	gazelle	93			32	8	464	597	78.3
Bos primigenius	aurochs	1					20	21	2.8
Ovis/Capra	sheep/goat	1					1	2	0.3
Sus scrofa	boar						1	1	0.1
Equus sp.	equid				1	13	81	95	12.5
Camelus dromedarius	camel						1	1	0.1
Medium Carnivores									
Canis sp.	dog/wolf/jackal						4	4	0.5
Carnivora medium	medium carnivore						2	2	0.3
Small Game									
Vulpes vulpes	red fox	5			2		6	13	1.7
Mustelidae	weasel						1	1	0.1
Lepus sp.	hare	1					19	20	2.6
Birds									
Chlamydotis macqueenii	bustard						1	1	0.1
Pterocles sp.	sandgrouse						1	1	0.1
Anser sp.	goose						1	1	0.1
Reptiles									
Testudo graeca	spur-thighed tortoise						2	2	0.3
Unidentified									
Mammalia large	large mammal	7			3		36	46	
Mammalia med.	medium mammal	86		1	53	2	18	160	
Mammalia small	small mammal	3					5	8	
Mammalia	mammal	78	43	131	220		1	473	
*Struthio camelus**	ostrich						3	3	
Aves	bird						1	1	
*Testudo graeca**	spur-thighed tortoise				3		104	107	
Total ID		101	0	0	36	21	610	768	100.0
Total UnID		174	43	132	276	2	61	688	
Total (ID + unID)		275	43	132	312	23	671	1456	

Although a systematic examination of butchery was not a practicable objective for the analysis of AS42, one uniquely butchered find from a Middle Epipalaeolithic deposit merits a brief description. The distal end of a fused *Equus* sp. femur from locus 107 was modified by two methods of butchery (Figure 10). One stage of the butchery process produced two rough, oblong holes that were percussively punched through the posterior and medial faces of the distal diaphysis. The location and size of these holes suggest that they were made for the purpose of extracting marrow. The other butchery modification on this femur is a set of two very deep, parallel chop-marks on the posterior face of the medial trochlea. Their location near the articulation points of the medial femoro-tibial ligament and the femoral ligament of the lateral meniscus suggests that the butcher's efforts were aimed at disarticulating the femur from the tibia. Most remarkably, a lithic fragment that broke from the butcher's axe remains embedded in the upper chop-mark.

Table 10. Relative proportions of the five most abundant taxa from Early and Middle Epipalaeolithic deposits in AS42. NISP values are from Tables 5 and 9. Difference-of-proportions test results (*z*-scores) and their probability values are also shown. * indicates significant *p*-values (p > .05).

	Early Epipalaeolithic		Middle Epipalaeolithic			
Taxon	NISP	%	NISP	%	*z* score	*p*-value
Gazelle	475	82.0	597	80.0	0.924	0.358
Aurochs	13	2.2	21	2.8	-0.651	0.516
Equid	53	9.2	95	12.7	-2.053	0.040*
Fox	22	3.8	13	1.7	2.316	0.020*
Hare	16	2.8	20	2.7	0.092	0.928
Total	579	100.0	746	100.0		

Discussion

The archaeological sequence of square AS42 gives us a small glimpse into the overall occupation history of Kharaneh IV. The top of the stratigraphic sequence in Square AS42 is characterized by a series of consecutive compact surfaces with a high density of artifacts. The density of the lithics from these deposits is overwhelming; from the sampled assemblage—of which two loci were not included—85,834 lithics were analyzed from the Middle Epipalaeolithic deposits of this 1 × 1 m square. There was often more cultural material than sediment while excavating these loci. The delicate nature of the deposits, as well as the preservation of delicate, in situ archaeological materials, suggests that this accumulation is not the result of deflation. The intensive, dense occupation of the site suggests a substantial number of people were involved in various activities in this area at Kharaneh IV during the Middle Epipalaeolithic occupation of the site.

Microliths recovered from the Middle Epipalaeolithic deposits are primarily geometric microliths, with unbacked trapezes and trapeze/rectangles, as well as a wide diversity of other geometric forms in low numbers. The trapeze/rectangles include both wide and narrow forms, representing a range of different trapeze-rectangles types. The microliths recovered from these deposits correspond with Muheisen's Phase D in his sequencing of the Kharaneh IV lithic assemblage (Muheisen 1988a, 1988b; Muheisen and Wada 1995). These microliths were predominantly produced on variably-sized and shaped blanks removed from non-standardized broad-faced cores, and heavily retouched to the desired final form. The wide diversity of microlith types recovered from these deposits suggests that there was a broad range of concepts about how microliths could be

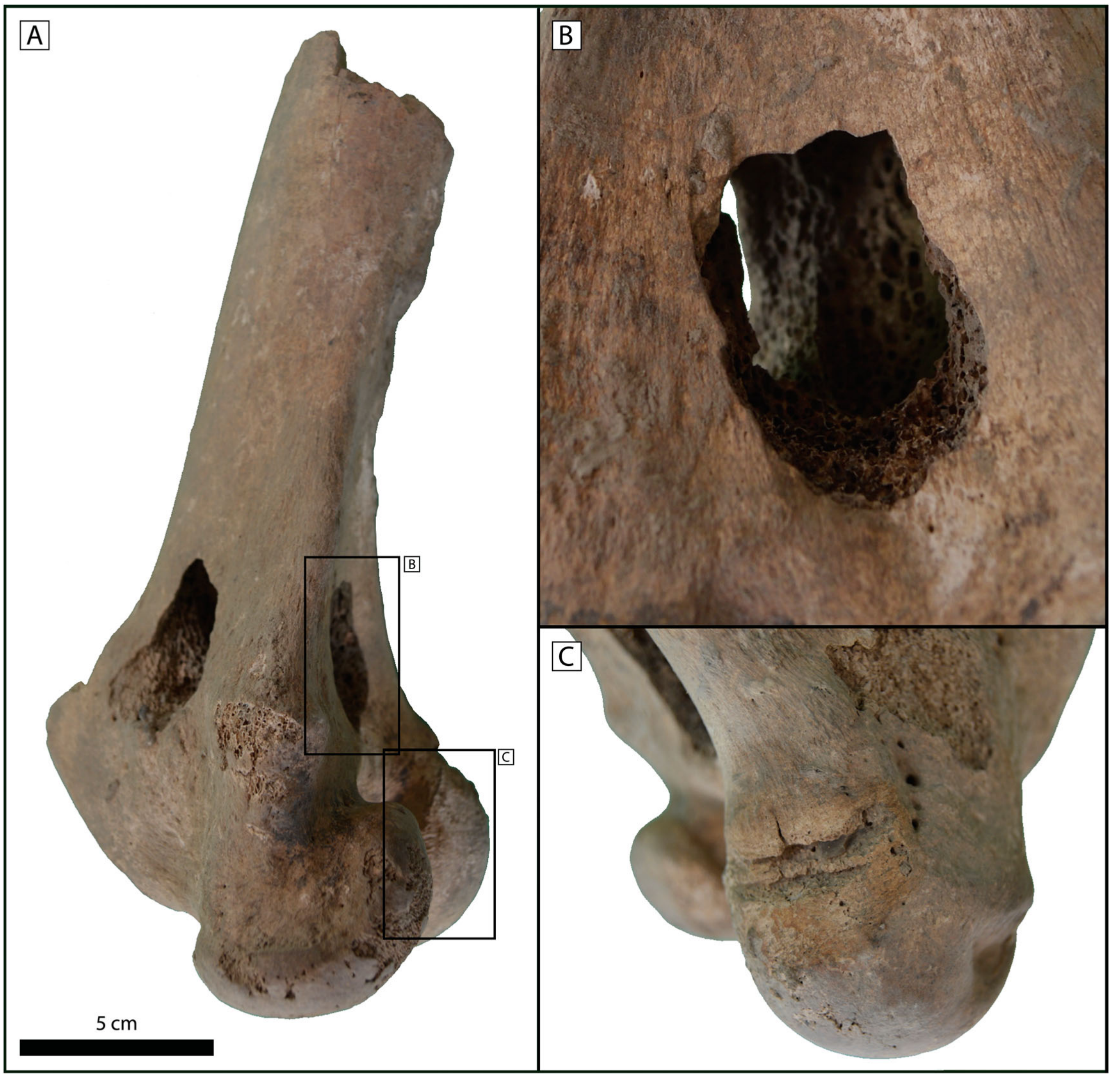

Figure 10. A) *Equus* sp. femur from a Middle Epipalaeolithic locus (locus 107) showing B) marrow extraction and C) disarticulation butchery showing detail of a lithic fragment embedded in a chop-mark.

made, and what form they might take. Use-wear studies on a selection of microliths from the Middle Epipalaeolithic deposits of Kharaneh IV shows that there is no correlation between the form and function of microliths at Kharaneh IV (Macdonald 2013). These tools were used primarily as insets for projectiles, but were also used for cutting soft materials, and there is no link between how a tool was used and the typological assignment of the microlith.

In contrast, lower stratigraphic deposits attributed to the Early Epipalaeolithic have a much lower artifact density. The microliths are primarily non-geometric, and the assemblage is dominated by obliquely truncated bladelets, microgravettes, pointed backed bladelets, and abruptly backed bladelets. The microburin technique was used in moderation for the production of microlith tools and the microlith blanks were made on narrow-faced cores that produce more regular blanks for microlith production. Although microburins are not common during the Early Epipalaeolithic west of the Jordan Valley, there are numerous sites to the east that have clear evidence for the use of the microburin technique during this time (Byrd 1988; Henry 1995; Olszewski 2011; Richter 2009b). These sites are often designated to the Nebekian culture, originally defined by Rust (1950) from Rockshelter 3 at Yabrud in Syria. These assemblages are primarily characterized by the presence of microburins and microlith assemblages that include arch backed, curved, pointed and backed bladelets. However, other Early Epipalaeolithic Jordanian sites with microburins have higher microburin index rates than the index for Kharaneh IV (AS42 restricted microburin index = 17.05). These include the Wadi al-Hasa sites with a mean index of 26.2 (Olszewski 2006), the other Azraq Basin sites with a mean index of 45.8 (Garrard and Byrd 2013: 343), and Ayn Qasiya (Area D) with a mean index of 28.21 (Richter 2009a). The relatively low microburin index from Kharaneh IV might be a reflection of differential use of the technique, or perhaps a reflection of the small sample size from this excavation unit. Alternately, it could represent a blending of the different congregating Early Epipalaeolithic populations, some of whom used the microburin technique and some of whom did not.

The lower Early Epipalaeolithic material in AS42 contrasts to the material found in the upper deposits in Area B, where Early Epipalaeolithic occupations are found on the surface. The Early Epipalaeolithic Area B occupations are characterized primarily by obliquely truncated and backed bladelets, without the use of the microburin technique (Maher and Macdonald 2013). This suggests that there may have been two different Early Epipalaeolithic phases at the site, perhaps separated chronologically or spatially. These distinct Epipalaeolithic cultural trends reflect observations made by

Muheisen during his 1980's excavations. Muheisen suggested four distinct phases at Kharaneh IV: Phase A = Ancient Kebaran, Phase B = Classic Kebaran, Phase C = Geometric Kebaran, and Phase D = Final Geometric Kebaran (Muheisen 1988a). Muheisen characterizes Phase A as "Ancient Kebaran" (a designation no longer used) based on the presence of microgravettes with bipolar retouch. Obliquely truncated blacked bladelets, commonly associated with the Kebaran, were absent from this phase. In contrast, Phase B is designed as Classic Kebaran based on the presence of obliquely truncated and backed bladelets with fine retouch. The description of Phases A and B match with the Early Epipalaeolithic lithic assemblages associated with AS42; the lower deposits (loci 115d, 115e, and 115f) are characterized by micrograevettes with bipolar retouch, while locus 115c is characterized by obliquely truncated and backed bladelets. Similar typological distinctions are noted at the Early Epipalaeolithic site of Ayn Qasiyya in the Azraq Oasis (Richter 2009a). At Ayn Qasiyya, the lithic assemblages from Areas A and B are characterized by obliquely truncated and backed bladelets, while Area D includes the microburin technique and arch backed bladelets. Richter suggests that the former areas represent Kebaran populations, while the later represents Nebekian groups.

The lithic assemblage from AS42 suggests three phases of occupation at Kharaneh IV. With no breaks in the stratigraphy, it suggests that there was continuous (here we mean regular, prolonged and repeated, but not necessarily permanent) occupation of Kharaneh IV throughout these different phases. The earliest phase of the site is characterized by the use of the microburin technique, and the presence of microgravettes, pointed and backed bladelets, and scalene bladelets, as well as the use of bipolar backing. The second phase continues to see the use of the microburin technique, with the intensive use of oblique truncated and backed bladelets. The tool assemblage from this phase also closely relates to the Early Epipalaeolithic assemblage in Area B, which is dominated by obliquely truncated and backed bladelets, although lacks the use of the microburin technique. The presence of the microburin technique in the second phase of AS42 suggests that there might be some mixed deposits in locus 155c or this deposit might be a palimpsest of different occupations. Alternately, this might represent a transitional period, with the presence of some geometrics, although in low frequencies, the use of the microburin technique, and the presence of obliquely truncated and backed bladelets. Finally, the third phase of the site is characterized by the dominance of geometric microliths in the lithic assemblage, including trapeze-rectangles and unbacked trapezes, along with other geometric forms in lower proportions.

The dramatic shift in technology and formalized tools from non-geometric microliths to geometric microliths correlates with the end of the wetland deposits at the site. It is during this transition from the Early to the Middle Epipaleolithic that we see a shift in the local environment, with increasing aridity that causes the localized shrinking of the wetlands, or at least areas of open, standing water until its eventual disappearance around 18 kya, coinciding with the abandonment of the site. It is at this paleoenvironmental shift, with lush wetlands shrinking to the expanse of a more extensive steppe and parkland, that we see this dramatic change in technology. In the Middle Epipalaeolithic phase, the third phase, we also see an increase in the diversity of microlith types at the site. If we accept the implicit idea that microlith types reflect different communities of knappers originating from different cultural groups and learned traditions of microliths production and use, then perhaps this increasing artifact diversity reflects an increasing diversity of people at the site over time. The high density of occupational debris in the upper Middle Epipalaeolithic levels and indications of communal hunting and food-processing evident in the faunal records (Martin et al. 2010; Spyrou 2015) and site features (Maher et al. 2016) suggests large numbers of people were living and interacting at the site, hinting at large aggregating groups of hunter-gatherers. With the onset of the Middle Epipalaeolithic period, we also note a greater reliance on large ungulates despite environmental changes that instigated the recession of the wetland.

Conclusion

Kharaneh IV was an immense locale on the Epipalaeolithic landscape, with occupations continuing for 1200 years. There is evidence for a range of activities, habitations, and interactions between different Epipalaeolithic communities at the site. The lithic and faunal evidence from AS42, currently the only location on site where we have clear evidence for stratified Early and Middle Epipalaeolithic occupations, indicates that the nature of these communities changed over time. The abrupt shift from lithic assemblages composed of non-geometric microliths and the use of the microburin technique, to those composed of geometric microliths, suggests a radical change in communities represented at the site. Alongside technological change, the faunal record demonstrates shifting relative frequencies of some animal taxa and continuity of others between the Early and Middle Epipalaeolithic periods. These forces of change and resilience correspond to a shift in the environment, as the wetlands and lakes surrounding the site began to dry up. Whether these technological and subsistence processes represent new communities moving into territories abandoned by the Early Epipalaeolithic people, or a shift in technological production in response to environmental change, is a question that still needs to be addressed. The increase in diversity of the Middle Epipalaeolithic assemblages suggests that the use of the site ratcheted up over time, with Epipalaeolithic groups aggregated at Kharaneh IV in higher numbers, and perhaps from greater distances. Whether the technological changes represent new people or new ideas, Kharaneh IV can be conceptualized as a persistent place on the landscape; somewhere with an enduring memory between communities and across time that caused people to return again and again to the same locale.

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No potential conflict of interest was reported by the author(s).

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