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Authors
Maher, Lisa A
Macdonald, Danielle A
Allentuck, Adam
et al.

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Occupying wide open spaces? Late Pleistocene hunter–gatherer activities in the Eastern Levant

Lisa A. Maher [a, *], Danielle A. Macdonald [b], Adam Allentuck [c], Louise Martin [c], Anna Spyrou [c], Matthew D. Jones [d]

[a] Department of Anthropology, University of California, Berkeley, 232 Kroeber Hall, Berkeley, CA, 94720-3710, USA
[b] Department of Anthropology, University of Tulsa, Harwell Hall, 800 S Tucker Drive, Tulsa OK 74104, USA
[c] Institute of Archaeology, University College London, 31-34 Gordon Square, London, WC1H 0PY, UK
[d] School of Geography, University of Nottingham, University Park, Nottingham, NG7 2RD, UK

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ABSTRACT

With a specific focus on eastern Jordan, the Epipalaeolithic Foragers in Azraq Project explores changing hunter–gatherer strategies, behaviours and adaptations to this vast area throughout the Late Pleistocene. In particular, we examine how lifeways here (may have) differed from surrounding areas and what circumstances drew human and animal populations to the region. Integrating multiple material cultural and environmental datasets, we explore some of the strategies of these eastern Jordanian groups that resulted in changes in settlement, subsistence and interaction and, in some areas, the occupation of substantial aggregation sites. Five years of excavation at the aggregation site of Kharaneh IV suggest some very intriguing technological and social on-site activities, as well as adaptations to a dynamic landscape unlike that of today. Here we discuss particular aspects of the Kharaneh IV material record within the context of ongoing palaeoenvironmental reconstructions and place these findings in the wider spatial and temporal narratives of the Azraq Basin.

1. Introduction

The Late Pleistocene in the Southern Levant witnessed hunter–gatherer groups engaged in a wide range of activities within a changing landscape. Archaeologically, these groups are characterised and distinguished by a suite of material culture items, including a chipped stone tool industry dominated by microlithic tools. Although microlithic industries (and other aspects of material culture) appear early in the Upper Palaeolithic, they overwhelm chipped stone tool technologies in the period between 23 and 11.5 ka BP, known as the Epipalaeolithic (EP). Spanning over 10,000 years, EP hunter–gatherers experience (and initiate) a wide range of economic, technological, social and ideological changes that include the symbolic use of space, elaborated art and decoration, a shift to more settled village life, the earliest domesticated animals (dog), and intensified exploitation of a wide diversity of plant resources. We continue to reconstruct the origins, impetuses and implications of these many transformations, inventions and innovations, as well as reconstruct evidence for large-scale interaction among contemporary groups throughout the Levant, Africa and Arabia (Maher et al., 2012b; Maher, in press a,b).

In this paper, we explore changing hunter–gatherer strategies, behaviours and adaptations to the wide open space of the Azraq Basin, located in eastern Jordan (Fig. 1), throughout the Late Pleistocene. In particular, we examine how lifeways in this vast area may have differed from surrounding areas and what circumstances drew human and animal populations to the region. Integrating multiple material cultural and environmental datasets (see also Jones et al., this volume), we explore some of the strategies of these eastern Jordanian groups that resulted in changes in settlement, subsistence and interaction and, in some areas, the occupation of substantial aggregation sites. Five years of excavation at the aggregation site of Kharaneh IV suggest some very intriguing technological and social on-site activities, as well as adaptations to a dynamic landscape unlike that of today. Here, we discuss particular aspects of the Kharaneh IV material record within the context of

* Corresponding author.
E-mail addresses: maher@berkeley.edu (L.A. Maher), danielle-macdonald@utulsa.edu (D.A. Macdonald), a.allentuck@ucl.ac.uk (A. Allentuck), louise.martin@ucl.ac.uk (L. Martin), a.spyrou@ucl.ac.uk (A. Spyrou), matthew.jones@nottingham.ac.uk (M.D. Jones).

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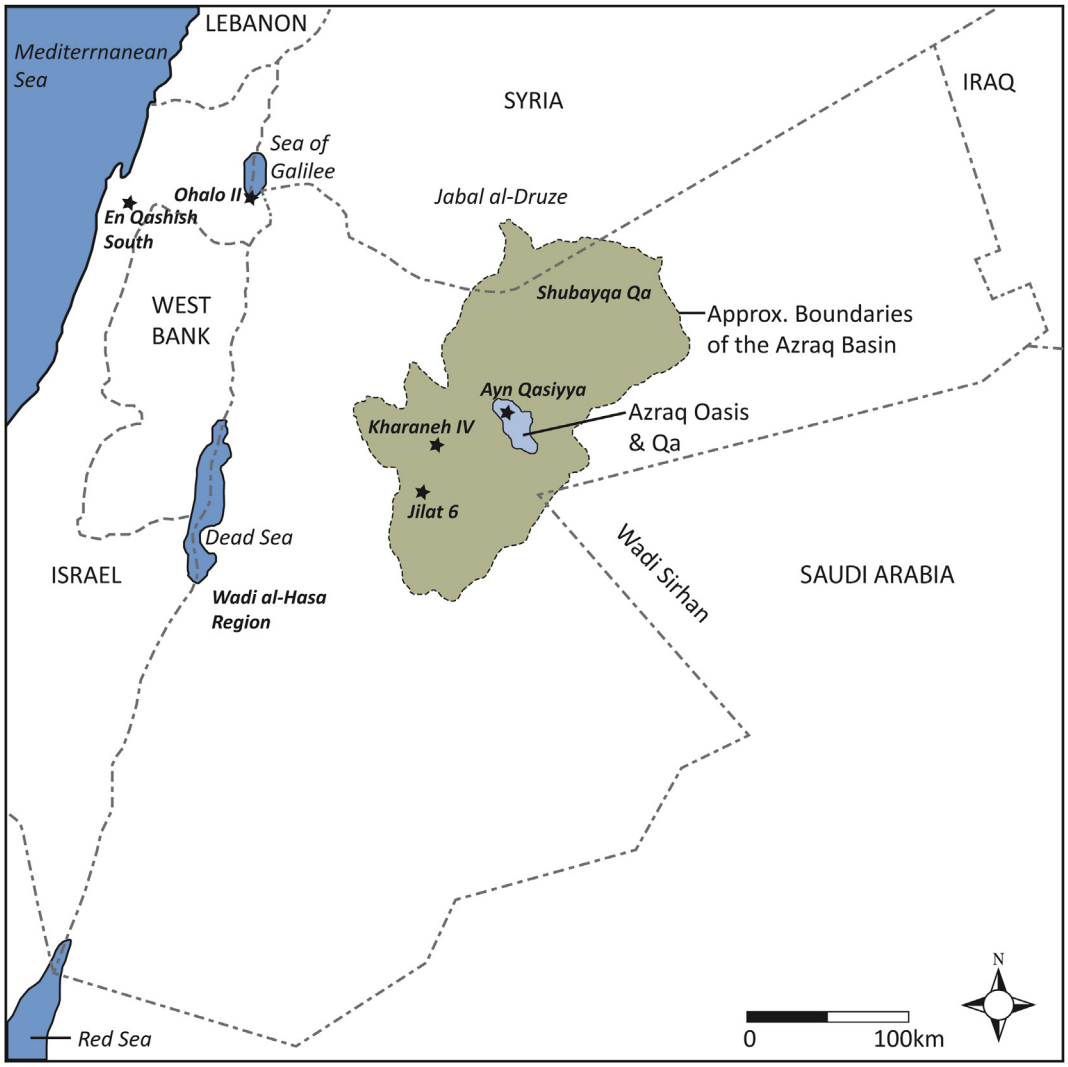

Fig. 1. Map of the Azraq Basin showing the extent of this hydrological system in eastern Jordan and the location of Epipalaeolithic sites discussed in the text (redrawn from Maher, in pressb).

ongoing palaeoenvironmental reconstructions and place these findings in the wider spatial and temporal narratives of the Azraq Basin and beyond.

In an attempt to characterise the complicated nature of spatial and temporal variability in material culture (especially microlithic tools), researchers have variously lumped and split the EP period into numerous facies/industries/cultures (Bar-Yosef, 1970; Goring-Morris, 1987; Byrd, 1994, 1998; Neeley and Barton, 1994; Henry, 1995; Goring-Morris and Belfer-Cohen, 1998; Olszewski, 2006) (Table 1). As a more nuanced culture-chronological framework for the numerous occupational horizons at Kharaneh IV is currently underway, for the present paper we will use the simple and easily comparable terms Early, Middle and Late EP (Olszewski, 2001; Pirie, 2004; Goring-Morris et al., 2009; Maher, 2010; Maher and Richter, 2011; Maher et al., 2011). Traditionally, Early and Middle EP sites are characterized by non-geometric and geometric microliths, respectively; while Late EP sites include a number of industries, with the Natufian being the most well-known (e.g., Bar-Yosef, 1998; Goring-Morris et al., 2009; Maher et al., 2012b). However, recent excavations at sites from throughout the EP are blurring these boundaries and shifting our attention to the rich evidence of other types of accompanying material culture (Grosman et al., 2008; Munro and Grosman, 2010; Richter et al., 2012, 2014; Nadel et al., 2013; Olszewski and al-Nahar, this volume; Yaroshevich et al., 2014).

At the Natufian sites of Raqefet Cave (Nadel et al., 2013), Hilazon Tachtit (Grosman et al., 2008; Munro and Grosman, 2010), and Shubayqa (Richter et al., 2012, 2014), evidence for very early floral linings for graves, special burial practices accompanied by feasting activities, and long-term and substantial occupation of groups outside of (but clearly culturally connected to) the Natufian core area (in the western Southern Levant) all point to a complex web of technological, social and symbolic activities. Going back even further in the EP, Early EP sites in the Wadi al-Hasa region of southern Jordan clearly point towards repeated occupation and the persistence of particular locations in the landscape (Olszewski and al-Nahar, this volume). Recent work at the Early EP site of En Qashish South also shows substantial occupation of the area accompanied by dwellings, clear site organization and the earliest engraved zoomorphic object in the EP (Yaroshevich et al., 2014).

In particular, work at Early and Middle EP sites from throughout the Levant is revolutionizing our understanding of hunter–gatherer landscape use and interaction. The presence of several

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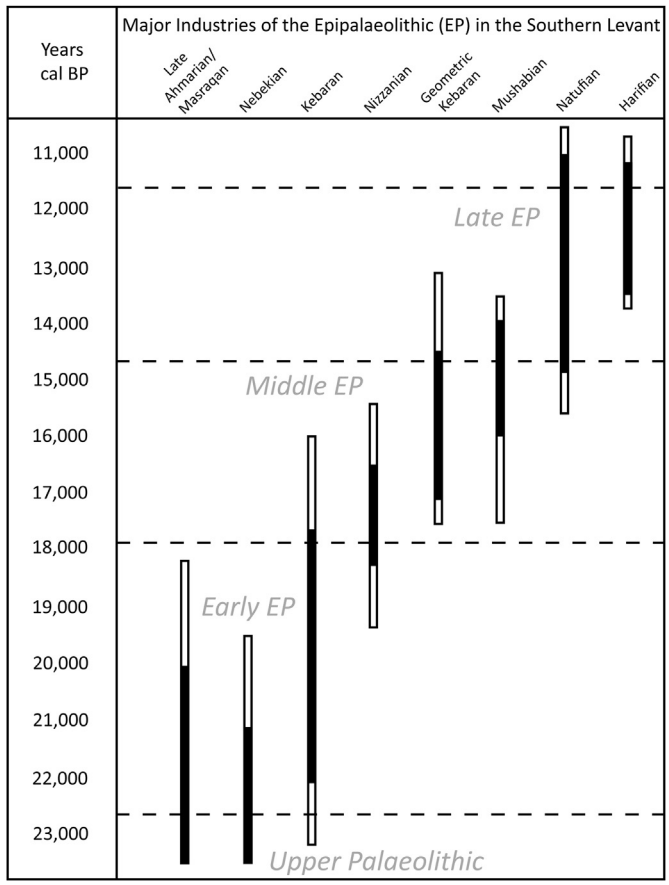
Table 1
Cultural-chronological framework for the Epipalaeolithic period (adapted from Maher et al., 2012b).



wide open spaces (e.g., steppic, grassland or open parkland ecologies, often situated near wetlands) in the eastern portion of the Southern Levant during the Late Pleistocene may have had important implications for groups occupying these habitats and likely shaped some of the differences we see in movement, settlement and land-use here. Both small and large Early and Middle EP sites in the south and east of the region were revisited and represented persistent places in the landscape (see also Olszewski and al-Nahar, this volume). At Kharaneh IV, we reconstruct an open grassland environment with a local wetland and a rich variety of local flora and fauna that encouraged repeated aggregation at the site over a 1200 year time span, as well as the participation of the site's occupants in wide-ranging social networks that extended to the Mediterranean and Red Seas, and probably deep into Arabia (Maher, in press a).

2. Regional setting and the site

2.1. Azraq Basin

The Azraq Basin is a large hydrological drainage system that extends over 12,000 km^2 (Fig. 1). It extends through much of eastern Jordan, from the Syrian highlands of Jebel Druze in the north, at an elevation of over 1000 m asl, to the Wadi Sirhan Depression in northern Saudi Arabia to the south. To the east and west, its borders are less well-defined, but include expanses of the Jordanian *harra* (basalt desert) and *hamada* (limestone rocky desert). Through a series of wadis, playas and underground spring and aquifer systems, surface and ground water within this vast area drains into the central Azraq Oasis, a wetland and playa (qa, in Arabic, approx. 500 m asl). As water moves from the far reaches of the basin towards the oasis, the boundary between underlying limestone bedrock and the overlying comparatively impermeable basalt traps water in an extensive network of underground aquifers that feed the two main springs in the central wetlands, Ayn Soda and Ayn Qasiyya. Although these spring are largely dried up today due to pumping of groundwater for irrigation and drinking water, they once supplied a lush marsh in the southern part of the oasis, while surface runoff created a large seasonal lake or playa in the north, connected to each other by a network of streams and rivers that have all disappeared over the last few decades. Studies of the groundwater in the oasis's aquifers indicate a residence time of up to 20,000 years (Noble, 1998; Al-Kharabsheh, 2000; El-Naqa, 2010) and today use of the groundwater occurs at a rate far exceeding the time needed for recharge. From its outer extent to the central oasis, the Azraq Basin includes a wide range of microhabitats, ranging from extreme desert to permanently watered oasis and the local flora and fauna reflect this diversity (Nelson, 1973).

Although modern industrial-scale use of the Azraq water resources has caused extensive depletion, geoarchaeological studies (Cordova et al., 2008; Jones and Richter, 2011; Ames et al., 2013, 2014;) suggest that a wetland, of one sort or another, was present in the Azraq Oasis for much of prehistory. This oasis served as an important and verdant locale for both local and migratory animal populations and, importantly for our purposes, local and migrating human populations. Sites dating to a range of prehistoric and

historic periods, from the Middle Palaeolithic onwards, are found throughout the oasis and the entire basin. Significantly for the EP, the basin exhibited a relatively positive water balance through the Late Pleistocene (Jones et al., this volume). How water availability varies away from the central oasis, in areas substantially above the aquifer, where groundwater-fed springs are less likely, remains less well understood. Geoarchaeological investigations in several wadi systems and playas document prehistoric sites throughout the entire basin, in some cases in high concentrations. However, as in more recent times, what prehistoric peoples considered as attractive locales seems to have changed over time, likely due to a variety of factors including water availability (e.g., Garrard and Byrd, 2013; Richter and Maher, 2013).

Palaeoenvironmental research documents generally good water availability throughout the basin in the later Pleistocene (Nelson, 1973; Besançon and Sanlaville, 1988; Besançon et al., 1989; Hunt, 1989; Cordova et al., 2008, 2013; Macumber, 2001; Jones and Richter, 2011; Garrard and Byrd, 2013; Ames et al., 2014; Jones et al., this volume). Previous archaeological research supports a lusher environment than today, noting a high density of Palaeolithic, EP and Neolithic sites, including some of the largest hunter–gatherer sites in the region (Muheisen, 1988; Copeland and Hours, 1989; Rollefson et al., 1997, 2001; Garrard and Byrd, 2013). Although travellers' reports note archaeological sites of various periods throughout the basin, the first detailed archaeological survey was carried out by A. Garrard and N. Stanley-Price (1975–77). Aside from highly localized survey and excavation of Palaeolithic sites in and around the oasis in the 1980s (Copeland and Hours, 1989), two large-scale research projects provide a wealth of data on Azraq's prehistory. Garrard and colleagues conducted survey, excavation and accompanying palaeoenvironmental work in several areas within the south and west of the basin (Garrard et al., 1988; Garrard and Byrd, 1992) as part of the Azraq Project. In particular, investigation of a series of sites in the Wadi Jilat offers a high-resolution record of prehistoric occupation and, notably, identified another large EP aggregation site named Jilat 6 (Garrard and Byrd, 2013). To the north, A. Betts worked at several Palaeolithic, EP and Neolithic sites in the 1980s and 90s as part of the Black Desert Survey Project, demonstrating that even the now-harsh basalt desert was an attractive locale in the Pleistocene (Betts, 1998).

Continuing research in the basin today, the Epipalaeolithic Foragers in Azraq Project (EFAP) is a regional-scale project interested in reconstructing hunter–gatherer lifeways during the Late Pleistocene and Early Holocene and understanding changing hunter–gatherer behaviours here in both temporal and spatial dimensions, especially in relation to better-studied areas to the west. Since 2006, EFAP has conducted excavations, and accompanying geomorphological work, at several EP sites in the oasis and beyond (Richter et al., 2012, 2014; Maher and Macdonald, 2010, 2013, 2013; Jones and Richter, 2011; Maher et al., 2012a,b; Richter and Maher, 2013; Maher, in press a, b). A summary of other sites investigated by EFAP is beyond the scope of this paper and so we limit discussion to our recent work at the Early and Middle EP aggregation site of Kharaneh IV.

2.2. Kharaneh IV

Kharaneh IV sits as a low mound, rising approximately 2 m above the surrounding terrace of the Wadi Kharaneh that flows eastwards along the southern margins of the site (Fig. 2). The site is extraordinarily large, conservatively recorded as 21,000 m^2 in size, and extremely dense in artifactual remains, making it a notable EP site in the landscape and for the region. Protecting the site's delicate underlying deposits from further erosion, a dense concentration of deflated flint and animal bone cover the site, marking its aerial extent with a shining, grey pavement. The site's deposits are at least 1.5 m deep, with high densities of artifacts and well-preserved, high-resolution, stratified occupational phases continuing throughout its depth. This high density of artifacts in the subsurface deposits suggests the now-eroded near-surface deposits likely held similar features before deflation created such a dense pavement.

The site was originally excavated by Jordanian archaeologist Mujahed Muheisen in the early 1980s, where he dug soundings in three areas, R/S2/60, K3/60 and D1/40, uncovering what he labelled as Kebaran and Geometric Kebaran industries (Muheisen, 1988). Here, he discovered the remains of hearths, postholes, floors and human burials. EFAP renewed excavations in 2008, focusing first on Muheisen's two main excavation areas, Area A (around D1/40) and Area B (around R/S2/60) and in subsequent years opening several 1×1 m soundings and a 9×1 m geological trench in the north and southern areas of the site (Fig. 3). These soundings, along with a detailed surface survey indicate that the visible aerial extent of the site is only very slightly exaggerated by deflation. Intact subsurface deposits are found over most of the mound, excepting a very small area around the site's edges.

Our work in Areas A and B demonstrate that the site's subsurface deposits are well-preserved and record remarkably detailed information about stratified occupational levels and activity areas within them. Multiple intact intramural and extramural surfaces, hearths, postholes, pits, flintknapping areas, middens, hut structures and caches of objects show astonishing preservation and provide a large quantity of associated material culture. Many of these features, especially the occupational surfaces, hearths and hearth dumps, are only millimetres thick and so we are able to reconstruct daily and repeated activities in incredibly high resolution. An abundance of charcoal from throughout these deposits allows us to anchor these deposits chronologically (e.g., Richter et al., 2013). Radiocarbon dates from throughout the occupational sequences in Areas A and B show striking concordance and indicate that the site was occupied between 19,830 and 18,600 cal BP (at 95% confidence), thus spanning just over 1200 years of the Early and Middle EP (Maher et al., 2011; Richter et al., 2013). The occupation in Area B is placed between 19,830 and 18,730 cal BP, while the occupation in Area A shows continuity from this and is dated to between 18,850 and 18,600 cal BP (Fig. 4). Determining the nature and duration of each occupational episode remains ongoing through evidence for seasonality from the fauna, radiocarbon dating of individual contexts, and micro-scale/micromorphological reconstruction of site formation processes. However, the density of material and nature of the site's stratigraphic record, as well as preliminary gazelle cementum analysis (Jones, 2012), suggest repeated, multi-seasonal and prolonged occupation over a 1200-year time span.

In both Area A and Area B, deep 1×1 m soundings in a corner of the excavated area reached sterile or near-sterile deposits at 2 m and 1.5 m, respectively (Fig. 3). In Area B, 1.5 m of dense occupational deposits ends at an abrupt boundary with a sterile, tan-coloured clay, with no mixing between the two deposits. The clay represents a low-energy, open-water deposit. The sharp truncation by habitation deposits indicates a relatively rapid drying of the wetland in this locale, and/or a sedimentary hiatus prior to Early EP occupation (see also discussion in Jones et al., this volume). In Area A, the relationship between basal deposits and habitation deposits, is a little different. Here, the occupational deposits extend much deeper (over 2 m below surface, and we have not yet reached fully sterile deposits) and intermix with water-lain deposits starting at 90 cm below the surface. Rather than rapid drying and disappearance of the wetland here, sediments suggest variable hydrological conditions, including tan-coloured clays and a greenish, carbonate-enriched and ostracod-bearing clay, some of which are very similar

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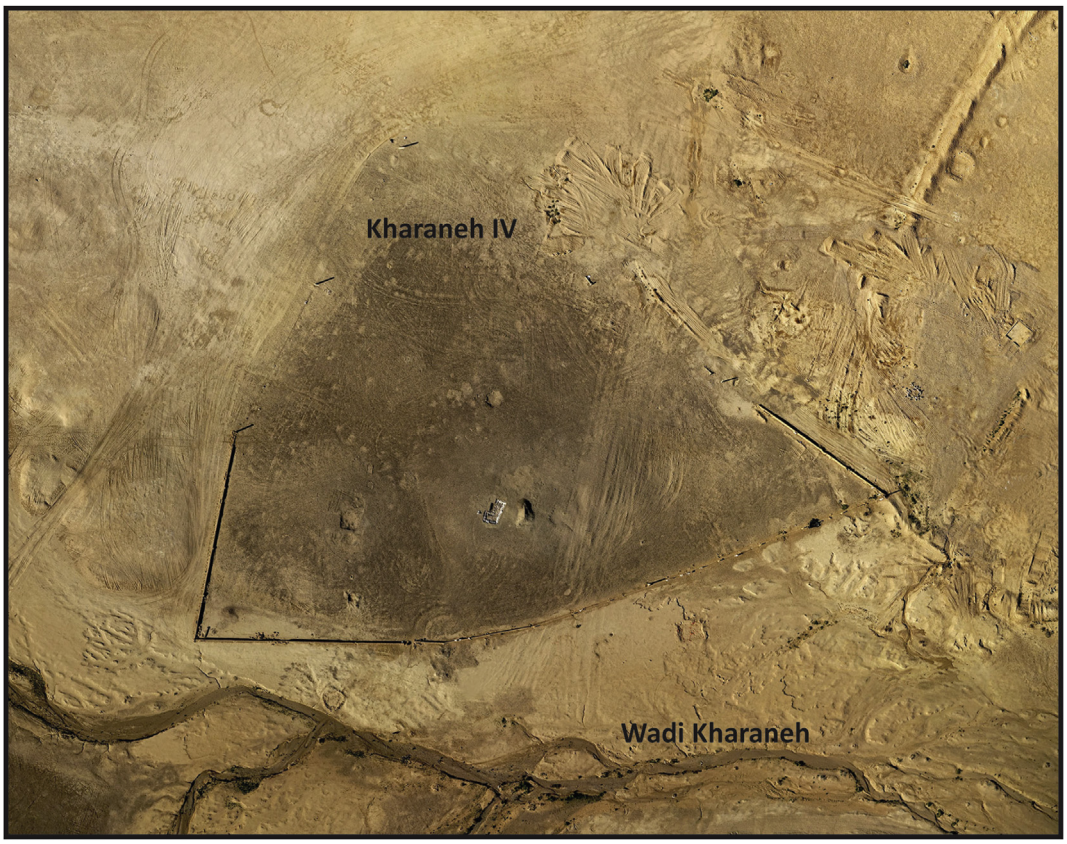

Fig. 2. The Early and Middle Epipalaeolithic site of Kharaneh IV sites as a low, flint-covered mound in the western portion of the Azraq Basin. It is situated along the northern edge of the Wadi Kharaneh, approximately 1 km to the south of the well-known Qasr Kharaneh. Here, berms constructed by the military can be seen to the north and east, while just out of the picture is a large water reservoir (image courtesy of A. Evans, Fragmented Heritage Project).

to Pleistocene lake deposits noted from the Azraq Oasis (Jones and Richter, 2011; Ames et al., 2014). Two soundings, one located in between these areas and the other to the north, confirm the presence of distinct wetland deposits (similar to those in Area A) at the base of the site. In one of these soundings (BS58), several postholes are dug directly into these deposits. A GeoTrench extending from the modern wadi terrace into the occupational deposits of the site along its southern margin documents the relationship between the off-site Pleistocene lake deposits and the basal site deposits, as well as provide clues to explain the notable differences in these basal deposits between areas. Here, overlying the tan-coloured clay of the modern wadi terrace surface, a greenish clay shows at least three distinct episodes of carbonate-enrichment suggesting that in the western portion of the site the local area was not completely dry during the initial occupation of the site. Intact flintknapping areas and other occupational deposits are found within the middle of these carbonate-rich horizons. Early and Middle EP occupation, therefore, likely hugged the edge of the wetland, with episodes of high water levels forcing abandonment and low levels allowing occupation. Subsequent inundations then deposited new clays, mixing with occupational material, and episodes of drying deposited calcium carbonate within these clays. In Area B, the highest part of the site, it is likely that evidence of occupation remained well-preserved, even during times of relatively low water levels.

On-site geoarchaeological work is paired with reconstruction of off-site landscape change through survey and description of several terraces along the Wadi Kharaneh and beyond (Jones et al., this volume and Fig. 2). Several sections document that a Holocene wadi fill sits unconformably on Pleistocene wetland deposits over much of the surrounding area. We are currently exploring the extent and nature of this wetland, especially in comparison to the on-site evidence for similar environments prior to occupation. However, one aspect of these findings is already clear: despite being located starkly out of place in one of the driest areas of Jordan today, palaeoenvironmental reconstruction of the local environs at Kharaneh IV paints a very different picture during the Late Pleistocene. Geomorphological work around the site (Jones et al., this volume; in press) indicate that the area included a fairly substantial wetland and supported a rich plant and animal community.

3. Aggregation in the open: the Kharaneh IV evidence

3.1. Stratigraphy of the occupational deposits

As mentioned, large horizontal excavations in Area A and B, each paired with a deep sounding into the underlying Pleistocene wetland deposits documents well-preserved, stratified deposits for the Early and Middle EP occupations. In both areas these deposits contain both high densities of artifacts as well as a diversity of features and activity areas (Maher, in press a). In Area B, we have excavated down to sterile basal clays and documented only Early EP material. This material clearly marks several superimposed occupational phases and may include more than one Early EP industry – most of the analysed material to-date is Kebaran with virtually no microburin technique – although further detailed analysis of the lithic assemblage by discrete locus is ongoing (see below and Maher and Macdonald, 2013). Radiocarbon samples taken from

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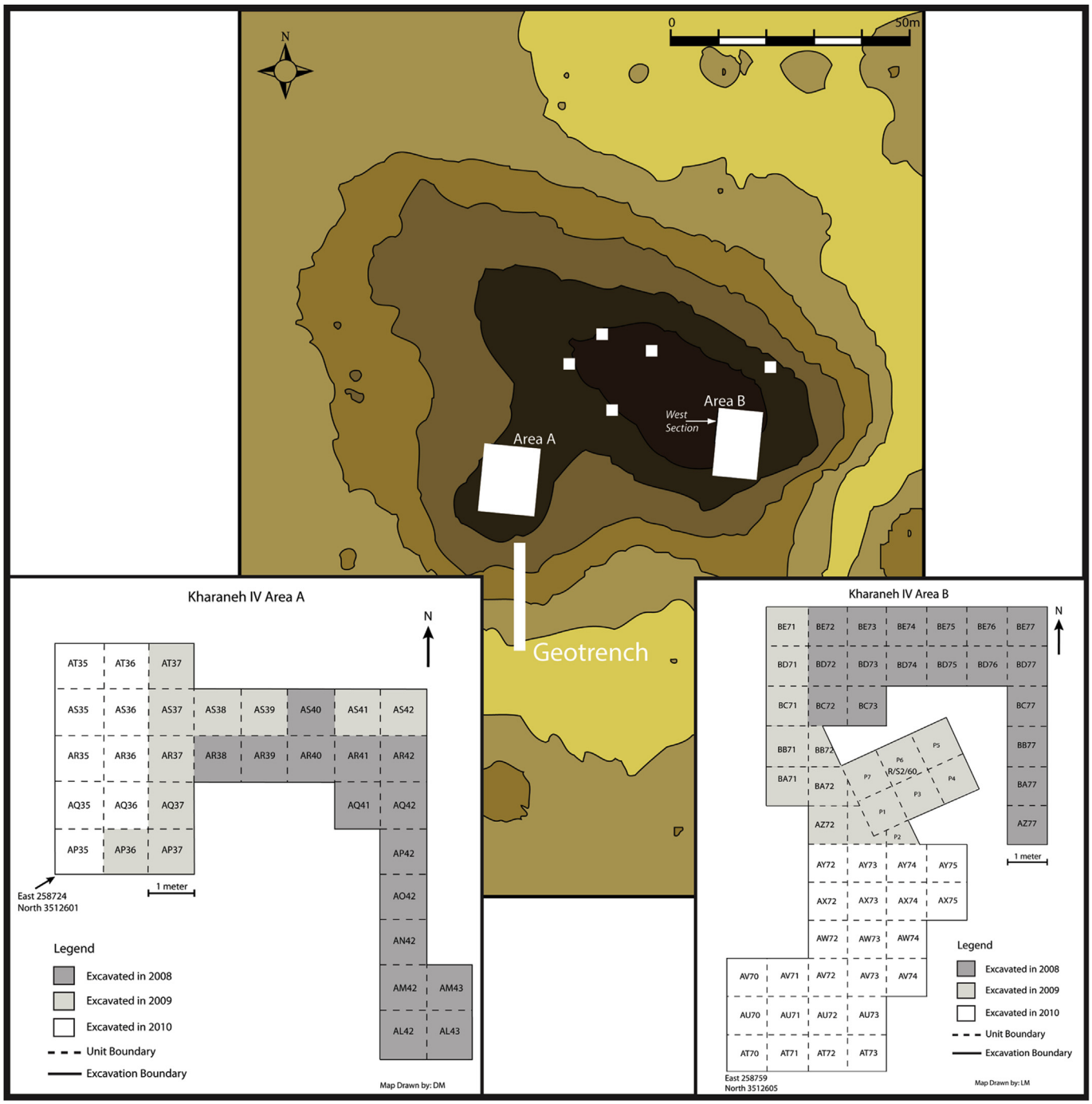

Fig. 3. Topographic map of Kharaneh IV showing the locations of our main excavation trenches, including Areas A and B discussed in detail in the text.

throughout the entire section of our deep sounding in Area B (Fig. 4) show a tight cluster of dates between 19,830 and 18,850 cal BP (Richter et al., 2013). In Area A, Middle EP occupational levels (with no noted mixing with Early EP material, indicating little movement of surface material across the site) extend to a depth of at least 90 cm (Fig. 4). Analysis of the lithics and fauna from a deep sounding in AS42 of Area A is currently in progress, but preliminary findings indicate that Middle EP occupation extend beyond this depth and overlies a possible late Early EP industry intermixed with the uppermost wetland deposits. A 1 × 1 m sounding placed in a shallow erosional gully between Areas A and B suggests that the Middle EP occupational may overlie Early EP in some areas of the site, but this doesn't seem to be the case (or at least Middle EP levels are not preserved) in Area B.

3.1.1. *The early EP occupations (Area B)*

The Early EP area preserves a complex sequence of deposits, many of which are small features with limited horizontal extent, such as pits, hearths and caches. The stratigraphy in this area is characterized by several pit features, and alternating layers of thin and compacted surfaces, hearths, middens, caches of lithics and gazelle horn cores, and ash dumps (Fig. 5a,b).

In 2010, 2013 and 2015, we uncovered the remains of several brush hut structures (three to-date, although see below, Fig. 6).

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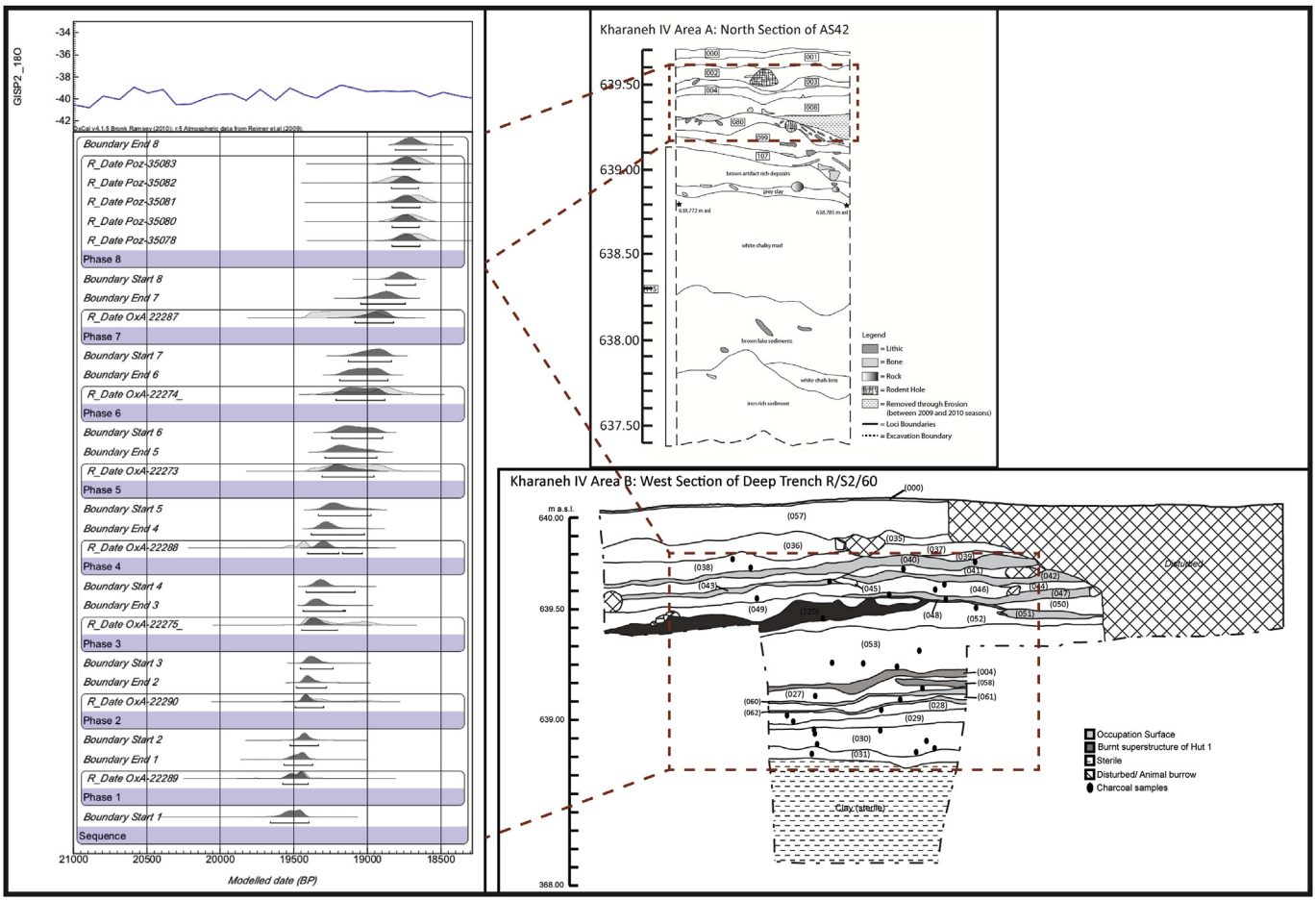

Fig. 4. Radiocarbon dates from Kharaneh IV (modified from Richter et al., 2013) shown against the excavation sections from which they derive in Areas A and B (EFAP Archive).

Only one of these structures, Structure 1, has been excavated in detail (Maher et al., 2012a), and a radiocarbon sample from the uppermost burnt layer provides a date of 19,400 cal BP (Richter et al., 2013). Similar to other contexts from this area, the sequence of deposits related to Structure 1 is complicated. The boundaries of this feature are clear, making interpretations of 'inside' and 'outside' the structure somewhat straightforward. However, the presence of several clearly related features and 'installations' in the small space between Structure 1 and 2, and the fact that Structure 3 partially overlaps Structure 1 along its southernmost margins, attests to a clear organization by the site's inhabitants to activities in this area. The presence of multiple floors in Structure 1 highlights re-use and maintenance of the structure; yet, at the same time, its intentional destruction and 'burial' (see below), followed by the establishment of Structure 3 in a somewhat different location also indicates that the hut's life history was finite. While Structure 3 is superimposed over and clearly post-dates Structure 1, the contemporaneity of Structures 1 and 2 is based on relative stratigraphic position of adjoining deposits. These include a probable hearth and several caches of lithics and gazelle horn cores all placed in the same deposit into which the structures appear to be dug into.

Structure 1 is just over 2 × 3 meters in size and exhibits a complex sequence of events related to its construction, use and abandonment. An organic-rich, black layer containing abundant charcoal fragments marks the former superstructure of the hut, burned after abandonment. Near the centre of the structure, on top of the burnt layer, are three distinct concentrations of pierced marine shells, each accompanied by a large chunk of red ochre (approx. 5–10 cm in diameter), around a large flat (anvil?) stone. These concentrations contain over 1500 shells from both the Mediterranean and Red Seas. The base of the structure appears dug into pre-existing occupational deposits to form a shallow depression sloping very gently towards the centre of the feature. The deposits inside the structure consist of three compact deposits, interpreted as floors, each of which is extremely rich in marine shell, cores, endscrapers and other macrolithic tools (alone and in concentrations), ochre, and polished bone points (Fig. 7). Situated beneath the burned layer, on top of the uppermost hut floor, are several groundstone fragments and the articulated partial vertebral column of an aurochs. Notably, microliths are rare from these contexts. There is no clear fire pit identified inside the structure, although several features such as concentrations of small and rounded cobbles inside and outside the hut suggest food preparation areas (or may represent supports for a superstructure). Phytolith and starch grain analysis of associated deposits are in progress. The presence of a high number of artifacts and several undisturbed caches inside the hut suggests these compact surfaces are *in situ*.

Excavation of Structure 2 commenced in 2015 and preliminary excavation of the structure suggests it to have similar deposits to Structure 1. The structure appears sloped towards the centre, suggesting that it was dug into the deposits below. The uppermost layer of this deposit is composed of highly burnt, organic-rich sediment. Artifacts in this sediment include a burnt set of articulated gazelle horn cores and a bone point (Fig. 8). Further

Fig. 5. Photographs of the section from our deep trench in Area B (EFAP Archive) showing (a) the well-preserved stratified deposits, including (b) a close-up of the alternating layers of thin, compacted surfaces (orange-coloured) and episodes of hearth clean out and dumping (grey-coloured).

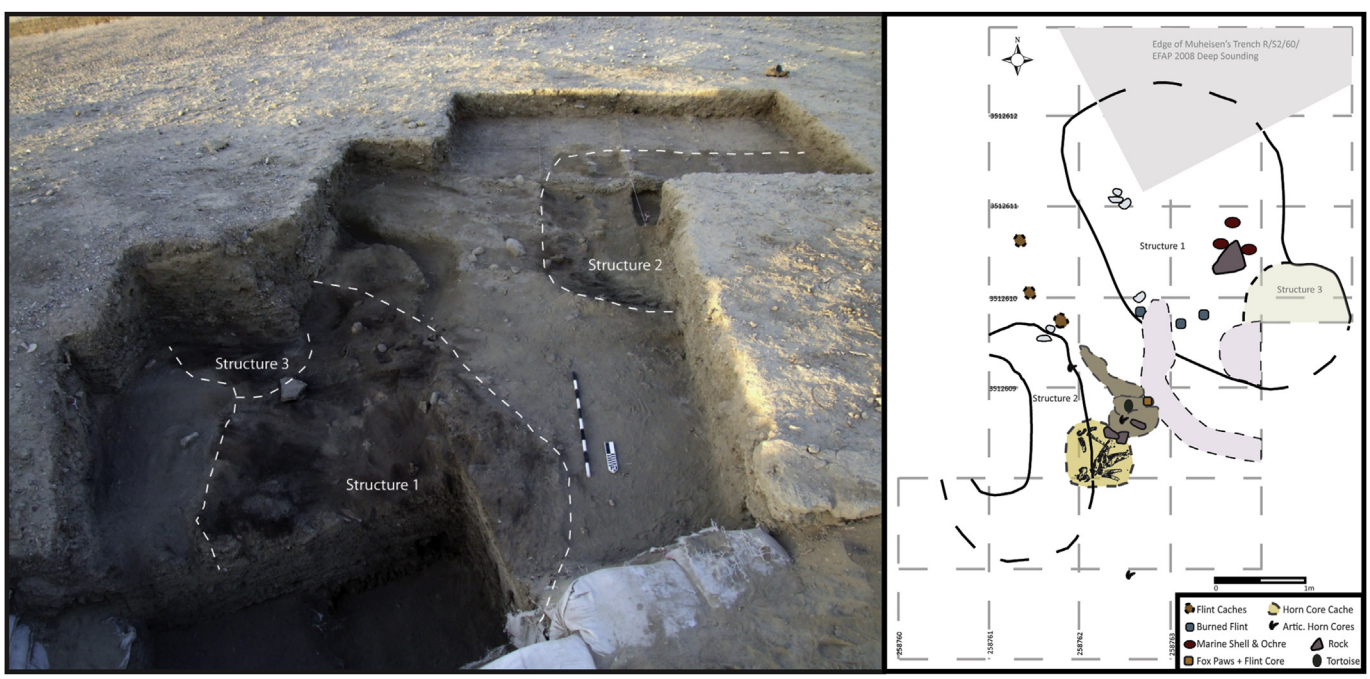

Fig. 6. Overview of the three hut structures identified to-date in Area B (EFAP Archive) as well as a plan view of the uppermost deposits of Hut Structure 1 described in the text (modified from Maher et al., 2012a).

excavations are necessary to determine whether Structure 2 contains stratified floor deposits similar to Structure 1.

Of note, a 1 × 1 m sounding to the north of Area B was excavated in 2010 down to sterile clays. At the boundary between occupational deposits and the clay several postholes were noted, one of which contained a large elongate piece of unworked flint with ochre-staining along its surface in the shape and size of a handprint (Fig. 9). This suggests that Early EP use of the site, and the construction of structures, was not limited to the remains discovered so far in Area B and may be quite extensive.

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Fig. 7. Photograph of the middle floor of Structure 1 during excavation (EFAP Archive). The deposits within the hut structure were excavated in 25 × 25 cm subunits and after all material on the floor was point provenienced, 100% of the deposits were collected for flotation. A detailed analysis of the spatial distribution of lithics, fauna, botanics and other contents is currently underway.

Finally, of importance for our discussion of Early EP site organization is the presence of several caches within and in between the hut structures. Described in detail elsewhere (Maher et al., 2012a) there are three distinct caches of marine shell and ochre

Fig. 8. (a) A burnt set of articulated gazelle horn cores (EFAP Archive) and (b) a well-worked bone point (EFAP Archive) from Structure 2 are similar to burnt horn core sets and bone points found in association with Structure 1 (Maher et al., 2012a).

Fig. 9. A flint nodule stained in red ochre discovered in a 1 × 1m test sounding to the north of Areas A and B (EFAP Archive). The nodule was found upright inside a posthole dug into basal lake deposits.

(see above) in Structure 1. These caches were found placed directly on top of the black organic-rich layer interpreted as the burnt remains of the hut's superstructure. One each of the hut's three superimposed floors were concentrations (perhaps caches) of flint blades (usually enscrapers), cobbles, animal remains, and in one instance a collection of bladelets and one core along with a polished piece of flint, marine shell and red ochre. A detailed reconstruction of spatial organization inside this structure, including micro-wear analysis of the stone tools, is currently underway (preliminary micro-wear results are discussed below). In the space between Structures 1 and 2 we noted several caches of bladelets with a core (three examples), one also containing a bone point, a cache of individual gazelle and aurochs horn cores (Maher et al., 2012a), articulated fox paws around a bladelet core interpreted as representing the remains of a fox pelt bag, and several examples of burnt, articulated gazelle horn cores placed upright. These caches may be utilitarian – as material stashed for later use – or may represent the symbolic placement, hiding, and/or burial of these items.

3.1.2. *The middle EP occupations (Area A)*

Excavations in the Middle EP component of the site have unearthed several horizontally-extensive occupation surfaces that, although not all are yet fully exposed, cover approximately 5 × 8 m to-date. They are associated with several superimposed hearths and a number of small postholes surrounding these hearth, all of which are artifact-rich. We have designated these deposits as surfaces due to their notable compactness in otherwise loose silty deposits, the presence of *in situ* material laid flat on this surface (including large animal carcass parts, sometimes articulated), as well as the hearth and postholes dug into them (Fig. 10). The postholes are all small in diameter, ranging from 5 to 10 cm, and so likely do not represent the supports for any type of substantial structure. In addition, they are situated adjacent to (and even surrounding) the hearths, thus we interpret their function as supporting small, ephemeral structures over or near a fire pit, such as for cooking, drying, smoking or roasting (see faunal section below). Radiocarbon dates place the occupations here between 18,800–18,600 cal BP, providing some of the oldest dates for the Middle EP (Maher et al., 2011; Richter et al., 2013). Despite these old dates, the presence of geometric microliths, particularly trapezes, rectangles and related variants of these, situates these deposits within Middle EP typologies (Maher and Macdonald, 2013). Thus, the Area A deposits of Kharaneh IV push back the dates for the Middle EP in the Levant.

3.2. *Lithics*

The excavated lithic assemblage of Kharaneh IV has been estimated to comprise over three million lithics from ~120 m^2 of excavated sediment. A sample of the excavated material from both

Fig. 10. A series of postholes around a series of superimposed hearths, with the lowermost hearth on the right, dug into a compact extramural surface in Area A (EFAP Archive).

the Early and the Middle EP areas has been analysed to understand the range of material present at the site and to identify technological trends. To date, the analysis of Kharaneh IV has focused on techno-typological classification, although a more detailed technological analysis is ongoing to understand sequences of manufacture during the Early and Middle EP at the site. In addition, a sample of microliths from the Middle EP area have been analysed for use traces, and two contexts from Structure 1 have also been analysed for micro-wear. The micro-wear analysis will be expanded to include other contexts to better understand the range of activities performed by the site's inhabitants.

The lithics from a range of Early EP contexts have been analysed, providing a general image of flintknapping behaviours at the site during the earlier phases of occupation. The Early EP assemblages at the site are characterized by gracile non-geometric microliths, representing over 80% of the overall tool assemblage from these deposits (Fig. 11a). Non-geometric microlith forms include obliquely truncated and backed bladelets, as well as micropoints (Maher and Macdonald, 2013). Larger tools include types typical of the Early EP such as endscrapers and backed blades. The complete *chaîne opératoire* is represented in the lithic assemblage, with a large number of cores, core trimming elements, debitage, and tools. Raw material choice was constrained in the Early EP, and the inhabitants of Kharaneh IV preferentially selected narrow flint nodules that were available in the immediate vicinity of the site. This choice in raw material was influenced by the technology used during the Early EP. Detailed analysis of the core trimming elements indicated that knappers focused on core preparation, in contrast to core maintenance, to produce standardized blanks for microliths (Maher and Macdonald, 2013). Cores are generally narrow-faced and small (Fig. 11a). The control of blank size and shape is integral for non-geometric microliths produced at Kharaneh IV as they were minimally retouched. Thus, the shape of the initial blank dictates the type of haft that can be used.

Analysis of the lithic assemblage from Structure 1 in the Early EP deposits suggests that a range of different behaviours were being enacted at the site. Lithics from two floor contexts were analysed with low- and high-powered microscopy to identify traces of use. Tools found within the structure have evidence of butchery traces and hide scraping traces, hinting at the types of activities that were taking place at the site. This analysis continues with the remaining lithics from Structure 1 and Structure 2.

The Middle EP component of Kharaneh IV has an extensive lithic assemblage showing evidence of all reduction stages including core preparation, maintenance, tool manufacture, and discard. The retouched lithic assemblage is predominantly composed of microliths at over 80% of the tool assemblage, with similar proportions of geometric and non-geometric microliths, although this may result from fragmentation (Macdonald, 2013). The geometric microliths are highly variable, but trapeze-rectangles still predominate, especially those in the form of backed and unbacked trapezes (Fig. 11b). There is more variability in microlith form during the Middle EP then during the Early EP. As well, Kharaneh IV has a wide range of 'rare' geometric microlith types and although these often occur in low frequencies, it suggests a wide range of different conceptions of how geometric microliths could look (Garrard and Byrd, 2013; Maher and Macdonald, 2013). Unlike the Early EP, there is greatly flexibility in the choice of raw material use during the Middle EP. The inhabitants introduced the use rounded nodules of varying colours for the production of geometric microlith blanks, although raw material survey of the region indicates all the material comes from within about 15 km of the site (Delage and Mangado, personal communication). Core trimming elements also shift from core preparation to core maintenance of broad-faced cores (Fig. 11b), suggesting that blanks did not require the same level of standardization as they did during the Early EP (Maher and Macdonald, 2013).

Micro-wear analysis of a sample of microliths from the Middle EP suggest that these geometric microliths were primarily used as projectile insets, with a small number also used in longitudinal motions on soft materials (Macdonald, 2013). For the projectile inserts, geometric microliths were used also exclusively as barbs or transverse tips, while non-geometric microliths were more variable in their hafting configuration as projectiles. Thus, projectiles at Kharaneh IV would have had geometrics hafted as barbs or transverse tips, and non-geometrics either hafted at the tip or also hafted in a similar manner to the geometrics. The presence of used projectile insets in the lithic assemblage suggests that the hunters were returning to Kharaneh IV to retool their projectiles, discarding the used implements on-site.

Although the lithic assemblage at Kharaneh IV is 'unique' in its large size and range of microlith types, it does not contain new types of microliths. Rather, the assemblage is composed of microlith forms known from other sites in the region (Maher and Macdonald, 2013). What makes this site 'unique' is the diversity of different types found in one locale, as well as the quantity of material. Maher and Macdonald (2013) have used the types, numbers, and widths of trapezes at Kharaneh IV to make the point that, if as we often assume, differences in geometric types and sizes are indicative of lithic traditions, then the presence of such a wide range of geometrics at Kharaneh IV substantiates the idea of aggregation and interaction of different groups at the site, each bringing their own lithic traditions with them.

3.3. Fauna

Ongoing analysis of faunal remains from the renewed excavations are corroborating and clarifying results from the previous

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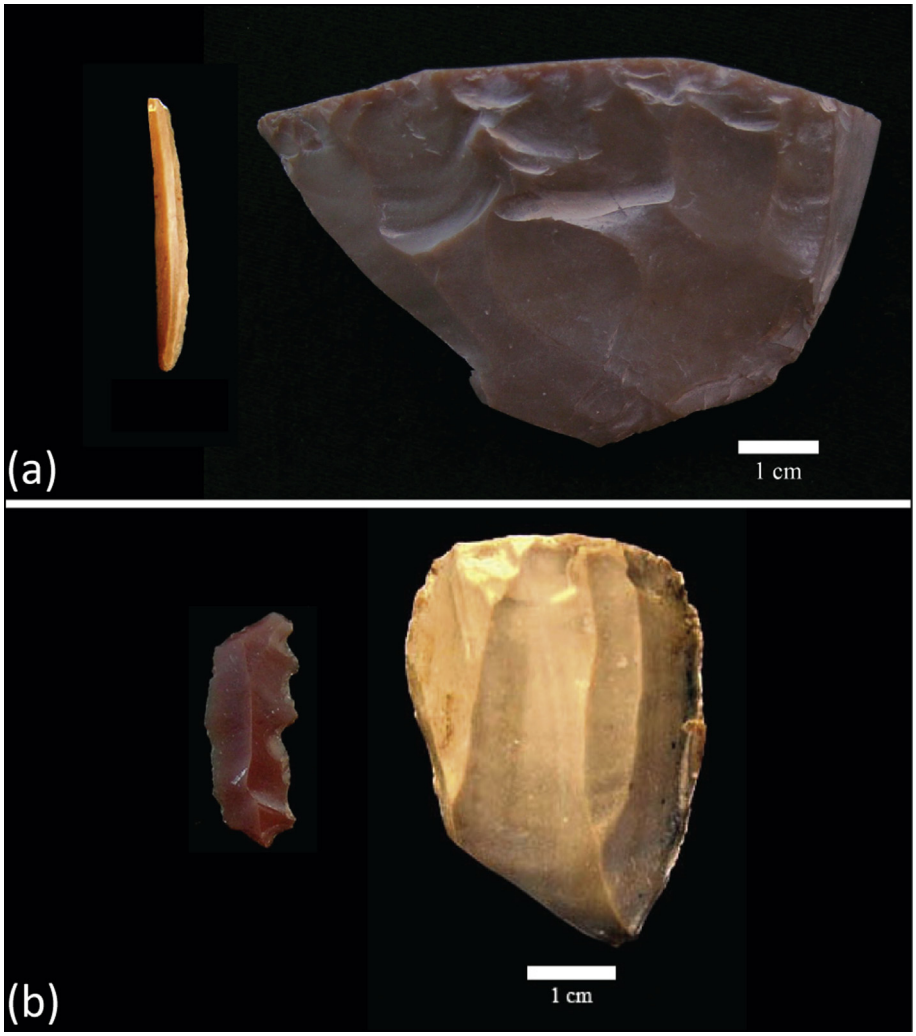

Fig. 11. Lithics from Kharaneh IV: In the Early EP non-geometric microliths and narrow-faced cores are typical (upper photographs), while in the Middle EP highly variable geometric microliths and broad-faced cores are more common (lower photographs).

campaign (Martin et al., 2010). The rich and well-preserved vertebrate faunal assemblage from Kharaneh IV emphasizes species endemic to the eastern steppe of Jordan. Gazelle (*Gazella* cf. *subgutturosa*) is the predominant animal taxon in all Area A and Area B contexts, accounting for 80–90% of the identified fauna in most loci. However, a wide range of other taxa, such as equid, aurochs, wolf/dog, fox, hare, tortoise, ostrich, and other birds comprise minor components of the site-wide assemblage. This variety of fauna reflects the diversity of locally available species in the late Pleistocene. The premise that aggregating foragers hunted and trapped their prey in the immediate catchment of the site is substantiated by non-selective carcass transport of all game, including large ungulates (Martin et al., 2010).

To date, over 39,000 animal bone and tooth fragments have been recorded from the Early Epipalaeolithic deposits in Area B. Although well preserved, the assemblage is highly fragmented, which has the effect of supressing the number of specimens that are identifiable to an anatomical element and a low taxonomic category (NISP = 3110). In keeping with previously published results, all anatomical regions of the most common animal prey are represented, which reflects non-selective carcass transport behaviours. Furthermore, a moderate quantity (n = 39) of fetal and neonatal bones of gazelle and gazelle-sized ungulate suggests that at least some gazelle were eviscerated on-site. Gazelle survivorship is estimated by calculating the combined proportion of fused epiphyses that fuse between 10 and 18 months from birth (Munro et al., 2009: 759, Table 4). The mortality data from Area B show that 41.8% of juveniles less than 18 months of age reached the adulthood threshold before they died. This result is in line with proportions of adult gazelle observed in modern living populations (Martin, 2000: 25–26). This proportion is also in close agreement with archaeological assemblages from Early EP sites in the Mediterranean Levant, such as Nahal Hadera V (41.1% fused) and Nahal Oren (45.6% fused) (Noy et al., 1973; Bar-Oz and Dayan, 2002). However, it diverges from results obtained from Tor Sageer (75.5% fused) and Tor-at Tareeq (91.7% fused), both Early EP sites in the Wadi al-Hasa in the western highlands of Jordan (Munro et al., this volume). The age-based selectivity evident in the Wadi al-Hasa stands in contrast to the opportunistic strategy evident in Area B of Kharaneh IV.

The taxonomic composition of the Structure 1 sample is markedly distinct from the midden, pit, cache and hearth contexts outside of this hut. Although gazelle account for the majority of identified fauna in both assemblages, they are less pervasive inside Structure 1. Moreover, gazelle comprise >80% of NISP in these other contexts, but they represent about 51% of NISP in Structure 1. Making up the bulk of the difference in the hut assemblage are

small prey, such as hare (*Lepus* sp., 7%), fox (*Vulpes* sp., 4%), and tortoise (*Testudo graeca*, 33%), which are comparatively underrepresented outside of Structure 1. These distinct taxonomic patterns are also reflected in anatomically articulating carcass parts. Articulating gazelle elements, particularly paired horn cores, are most conspicuous in pits, middens and around a hearth (Fig. 8). By contrast, tortoise carapaces and paws of hare and fox are most common in and around Structure 1 (Fig. 6). These divergent patterns are likely a product of different post-discard taphonomic histories and alternate uses of space. An intra-site spatial analysis of the Area B faunal remains is in progress and promises to clarify these and other patterns.

Over 10,000 bone fragments have been identified, recorded and analyzed from the Middle EP deposits in Area A. In this assemblage (NISP = 3761), gazelle is the dominant taxon (90%). Large ungulates, such as Equidae (4%) and aurochs (*Bos primigenius*, <1%), represent minor components of the sample. About 4% of the identified sample was assigned to small animals including hare (3%), fox (1%), and medium carnivores (i.e., hyena and jackal, <1%). Tortoise accounts for 0.2% of NISP and consist mainly of carapace and plastron fragments and a few long bones. Bird remains contribute the remaining 0.1% of the assemblage and include ostrich (*Struthio camelus),* buzzard *(Buteo buteo)*, coot *(Fulica atra*) and common kestrel (*Falco tinnunculus).*

Epiphyseal fusion data from the Area A assemblage show that fewer than 10% of gazelle in the 3–7 month age group and 35% of gazelles in the 7–18 month age group were culled. The low relative frequency of juvenile gazelle in the sample may indicate an aspect of herd demography, such as a low birth rate or births not occurring more than once per year. However, a targeted hunting strategy that selects against immature gazelle may also explain the results.

Mirroring results from Area B, a complete skeletal part profile of gazelle in the Area A assemblage suggests that hunting occurred fairly close to the site. Taphonomic analysis shows that aberrations in skeletal element frequencies are mostly related to density-mediated attrition. Butchery evidence reflects intensive carcass processing focused on meat and marrow extraction, in addition to selective removal of gazelle metapodia for tool manufacture. Underrepresented foot and skull elements from fox and hare may indicate their attachment to skins. Their low relative frequencies may be due to use-lives that differed from other fox and hare skeletal parts such that they were deposited beyond the Area A excavation trenches.

While hut structures such as those found in Area B are absent in Area A, the spatial distribution of gazelle body parts in the context of hearths surrounded by postholes has demonstrated that Area A was a locus of subsistence production activities, such as animal carcass processing, preparation and perhaps preservation by drying.

A broad pattern that emerges from this brief overview is a faunal spectrum that remains unchanged over the Early and Middle EP periods. This diachronic consistency witnessed over about two millennia of the late Pleistocene supports a palaeoenvironmental reconstruction of the Azraq Basin as a persistently sustainable locale for human and animal populations (Jones and Richter, 2011; Maher, in press b). The aforementioned differences between the Early and Middle EP faunal assemblages with respect to the taxonomic relative frequencies are most likely attributable to differences in site function and distinct uses of space. This is made clear when comparing gazelle relative frequencies between the open-air activity areas of Area A and the midden, pit, and hearth features of Area B (80–90%) on one hand, and Structure 1 in Area B (55%) on the other hand.

The zooarchaeological data now coming into focus are lending further support to the notion of Kharaneh IV as a site of recurring aggregation. The dominance of gazelle and their complete skeletal part profiles in both Area A and B assemblages show that this resource was sufficiently abundant, proximate, and predictable. A detailed reconstruction of gazelle mobility in the Azraq Basin using evidence from stable isotopes is the promised output of a current Leverhulme Trust Research Project (RPG-2013-223). Evidence of intensive carcass processing in Area A, alongside body part data and detailed bone surface modification analyses, hints at attempts to preserve some animal nutrients for possible storage. Clusters of bones with a 'high dryability index' (Binford, 1978) around the Area A postholes mentioned above, might strengthen the suggestion of nutrients being dried for purposes beyond immediate consumption (Spyrou, 2015). The caching of some animal parts, such as gazelle and aurochs horns, suggests either raw material or more symbolic 'investment' in the site for future visits. Add to this list of activities hunting small and large ungulates, trapping small fur-bearing mammals, collecting tortoises, birding, skinning, butchery, and bone tool manufacture, and we gain a picture of Kharaneh IV as a settlement at which a diverse range of domestic activities were carried out in order to support a commensurate human population. When we consider this evidence in the context of superimposed hearths, a succession of three floors in Structure 1, and a series alternating middens and compact surfaces, Kharaneh IV appears as a perpetual anchoring point on the landscape, one that continually drew people to return.

3.4. Archaeobotanical remains

Detailed analyses of various aspects of the archaeobotanical assemblage are currently in progress by specialists and as the subject of several doctoral dissertation projects. Most of the archaeobotanical remains are in the form of charcoal, excellently preserved in abundance in the dry desert climate. A preliminary identification of several samples from Early EP levels sent for radiocarbon dating indicates the presence of tamarisk, chenopods, and a variety of grasses (E. Asouti, personal communication, 2010). Examination of the seed assemblage (Bode, forthcoming) suggests a variety of other subsistence and non-subsistence species. Preliminary phytolith work indicates that grasses and wetland reeds and sedges were found extensively throughout the Early EP levels (Nicolaides, 2012; Ramsey, personal communication). Ongoing phytolith and starch grain analysis from Early and Middle EP phases should further refine our knowledge of the variety of plants utilised on-site for a variety of functions. The picture we are beginning to put together from the archaeobotanical remains is that of an open, but rich wetland and grassland environment.

3.5. Shell

Marine shells are common at Kharaneh IV, in a variety of contexts and through all occupational phases. The presence of shell is not unusual as marine shell is known from EP sites throughout the region (e.g., Bar-Yosef Mayer, 2005). However, it is surprising to find such high frequencies of shell at Kharaneh IV, at quantities greater than most other EP and Neolithic sites, even those along the coasts, and at sites throughout the Azraq Basin far away from their source (Reese, 1991, 1995; Richter et al., 2011; Garrard and Byrd, 2013).

Studies of the marine shells from both Early and Middle EP contexts at Kharaneh IV identified *Nerita sanguinolenta* (native to the Red Sea) and *Mitrella scripta* (native to the Mediterranean Sea) as the most common species (Richter et al., 2011). *Antalis* sp., formerly known as dentalium, found cut into small ring-shaped segments is also common, especially in Middle EP levels (Fig. 12). *Nerita sanguinolenta* are present in small numbers from the Early EP levels onwards, but increase in frequency toward the Middle EP

Fig. 12. Marine shell from the Mediterranean and Red Seas Kharaneh IV appears at Kharaneh IV in virtually all occupational contexts.

(Richter et al., 2011). In contrast, *Columbella rustica* and *Conus meditteraneus*, are found in relatively large numbers from the Early EP and decrease slightly in abundance towards the Middle EP. Microscopic examination of the shells for manufacturing traces shows evidence for intentional modification was extremely common (Allcock, 2009), including drilling, piercing, denticulating, sawing or cutting, and ochre-staining. Microscopic use-wear traces also suggest the shells were strung, probably together. This is not surprising if these small and delicate objects were intended to be transported any distance. We usually find these shells individually or in large caches throughout the occupational deposits and, thus, it is probable that they served a wide range of functions, such as worn as beads or hung as pendants, were adornments of clothes or other objects, or even used as currency. The presence of these shells in caches – both as individual shells in lithic caches or as caches of hundreds of shells, such as in the deposits sealing Structure 1, suggest they may also have symbolic import.

Marine shell from both the Mediterranean and Red Sea shells (and, rarely, shells native today to the Indo-Pacific Ocean, Richter et al., 2011) indicates that the occupants of Kharaneh IV participated in wide-ranging networks of interactions with groups outside the Azraq Basin. Connections to contemporary sites to the west and in Arabia is reinforced by other lines of evidence, such as trends in microlith production (Maher and Macdonald, 2013; Maher, in pressa). It thus seems apparent that the Azraq Basin and Kharaneh IV, in particular, was linked into a network of movement (of people) and material exchange (of shells, knapping techniques) throughout the southern Levant and Arabia. The movement and exchange of shells can, thus, be interpreted as the establishment and maintenance of social, symbolic and economic relationships between groups that served to affirm ties within and between communities (Richter et al., 2011). While we do not know the exact nature of these interactions or exchanges, it is clear that EP people in the Azraq Basin were part of large-scale, regional hunter–gatherer movements in a social landscape. Not only was the 'open space' of Kharaneh IV, and the larger Azraq Basin, an attractive locale for economic reasons, but for social ones as well.

4. Discussion

Beyond the caching activities and abundance of marine shell, a number of other deposits and features from both the Early and Middle EP occupations are suggestive of a variety of symbolic behaviours. The insertion of an ochre-stained nodule of flint in a posthole is described above. Described elsewhere (Maher et al., 2012b), we also have a large number of modified bone objects from both Early and Middle EP areas, although they are notably more common in the Middle EP. Aside from the commonplace bone points, they include several gazelle mandibles with a continuous series of incisions along one margin and several ribs with incised

lines running perpendicular to the long axis of the bone in patterned distributions (see Maher et al., 2012a:Figure 5). That we find these in both main occupation phases and a variety of contexts suggests some degree of persistence in the ideas/notations/designs over time, even if we can't yet (or ever) understand the significance of these pieces. We also discovered one fragment of soft limestone bevelled along one edge and with abstract and ladder incisions on one surface (Maher et al., 2012a:Figure 5). Finally, during Muheisen's original excavations two human burials were excavated from Area B and are described in Muheisen (1988) and Rolston (1982). We reconstruct at least one of these as being found below Structure 1. In 2009, EFAP discovered a single human tibia within a pit also containing gazelle remains and several endscrapers.

With the evidence from Kharaneh IV of a) several hut structures, maintained and re-used in at least one case, b) outdoor, probably shared, food processing areas, c) lithics indicating shared technological know-how but intentional variation in final tool form, d) placement of burnt, articulated gazelle horn cores and caches of knapped stone, marine shell and horn cores in association with hut structures, e) an abundance of pierced and ochre-stained marine shell in a variety of contexts, f) incised stone and bone (Maher et al., 2012b), as well as the presence of at least two complete human burials and the isolated remains of a further individual in a pit with gazelle remains (Maher et al., 2012b), it seems possible that the aggregations at Kharaneh IV involved a community (e.g., Conkey et al., 1980; Isbell, 2000; Habu, 2004) of hunter–gatherers with economic, social and symbolically-charged spaces. We have evidence for substantial numbers of people (admittedly, as at all sites of this nature, exact numbers elude us and we base this on the extraordinarily high densities of lithics and fauna) coming, or at least interacting or trading with others, from far distances. Well-preserved occupational deposits indicate a variety and high density of activities taking place during occupation. The re-use of Structure 1 suggests that these huts were not simply flimsy and ephemeral, but that their occupants made themselves 'at home' here. If we step back to trace the source of materials at the site, we see that interactions involving both objects and the knowledge to make objects indicates social interactions on a larger regional scale. If we were to map out these activities on the landscape, tracing paths and movements over space, we would likely get a very complicated map (Fig. 13). Rather than Kharaneh IV being an isolated dot (albeit a large one) in Jordan's eastern desert, we would see a number of sites, including Kharaneh IV and Jilat 6 and those in the Wadi al-Hasa, as nodes of interaction. These sites are not the islands in the desert they appear today, but mark the intersections of pathways and were persistent places in an inhabited landscape.

If we step back from Kharaneh IV to look at the broader Azraq Basin, we see clearly that Kharaneh IV is just one of many notable EP sites. The only other similar site in size and density to Kharaneh IV, Jilat 6, is located only about 20 km to the south. Here, Garrard and colleagues conducted test excavations at this ~19,000 m^2 site and already in these small soundings uncovered evidence for a fire

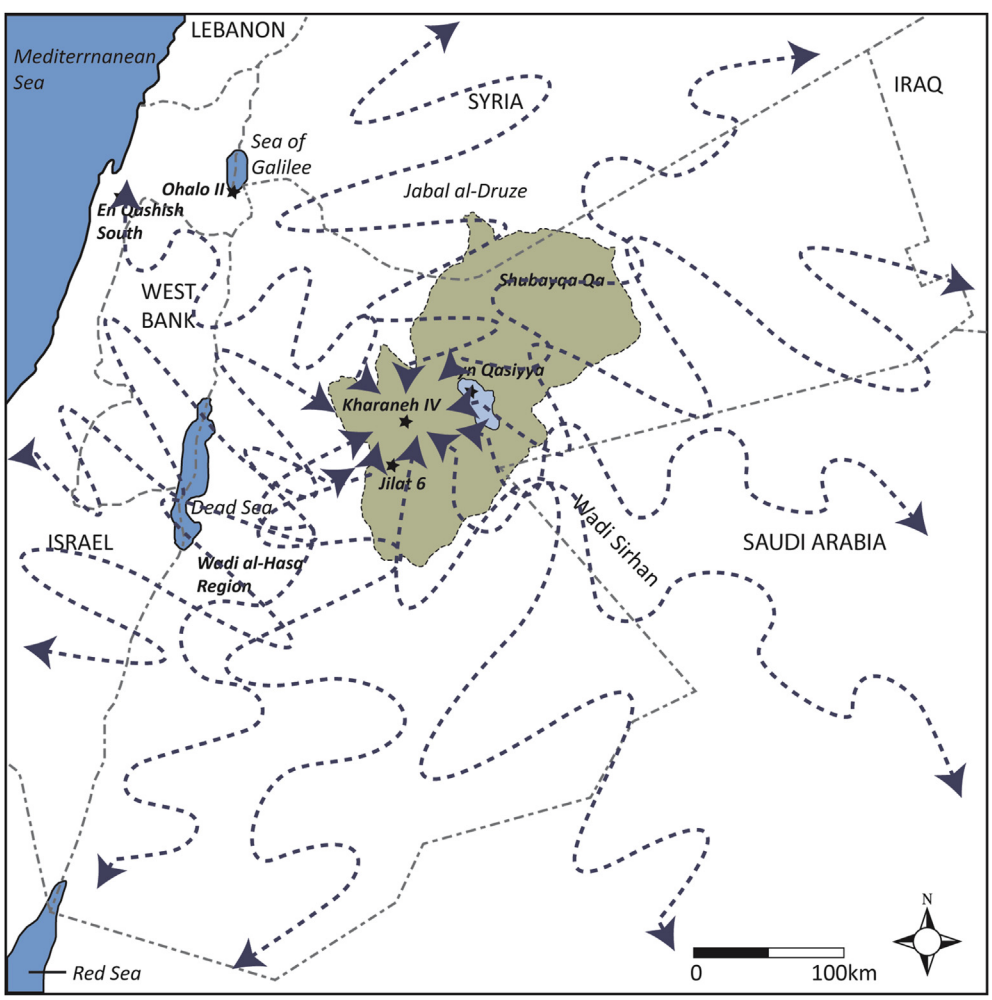

Fig. 13. A map of the region showing possible movements of EP in and around the Azraq Basin (redrawn from Maher, in press b).

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pit and floor, one of which appears to be ochre-stained (Garrard and Byrd, 2013). Notably, geomorphological analysis of the sediments from these trenches also indicates the presence of a body of water prior to and during occupation of the site. Although on a smaller scale, substantial and repeatedly occupied EP sites are known from the Uwaynid area to the southwest of the oasis (Garrard and Byrd, 2013), and excavations at the Early and Late EP site of Ayn Qasiyya in the oasis itself indicate repeated and persistent use of this marsh environment, including for interring human remains (Richter et al., 2010a, b). Previous and current work at Late EP and early Neolithic sites in the Shubayqa area to the north document intensive use of these open spaces as well (Betts, 1998; Richter et al., 2012, 2014).

If we step back even further to look at the southern Levant, we see a similar attachment to particular places. In southern Jordan (Henry, 1995) and the Wadi al-Hasa (Olszewski and al-Nahar, this volume) recurrent occupation of specific places suggests that these 'open' landscapes were attractive spaces for hunter–gatherer groups over the long term. Even if we look at the traditional 'core' EP area to the west, sites there confirm connections to specific locales, open or not. At Ohalo II, several hut structures document multiple episodes of re-use and maintenance, and analyses of evidence from intra-mural spaces suggests a clear organization of activities such as flintknapping and food processing (Nadel and Werker, 1999; Nadel, 2002; Nadel et al., 2011, 2012). The UP/Early EP site of Ein Gev I documents a structure with cobble paving, associated hearths, and a human burial beneath its floor (Bar-Yosef and Arensburg, 1973). Recent excavations at the Early EP site of En Qashish South continue to reveal clear patterned use of space with distinct flintknapping areas, butchery areas, stone installations, and a dwelling structure (Yaroshevich et al., 2014).

5. Conclusions

The location of Kharaneh IV in the so-called open spaces of eastern Jordan highlights the significance of these spaces, and particular places within those spaces, in the EP landscape. So, throughout the Southern Levant, we argue for a landscape of interacting sites, connected through the interweaving of people, places, things, and waypoints, such as Kharaneh IV. Kharaneh IV is just one of these many sites where we see abundant and varied evidence for mobility and aggregation, evidence for a substantial investment in place and locality, and intensive use of 'wide open spaces', which were, in essence, not as wide and open as we once thought.

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