

## Pleistocene Forager Mobility in the west-central Jordanian Highlands –a Landscape Approach

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### Abstract

This paper uses the incidence of retouch to assess the relative degree of mobility and duration of landscape occupation characteristic of Stone Age foragers in west-central Jordan based on survey lithic data. The incidence of retouch offers a measure of residential stability, and retouch scaled to artifact density gives some indication of the relative importance of curated and expedient assemblages. A higher incidence of retouch indicates greater residential mobility, smaller groups, shorter occupations, and low overall lithic densities. It is expected to occur during dry periods when resources were less predictable in terms of location. A high incidence of cores and *débitage* and few retouched pieces indicates a reduced need for conserving behaviors, greater residential stability and larger groups during wet periods when resources are more predictable and when raw material sources are known. Data from five subdivisions of the Paleolithic are cross-classified against three phytogeographic zones. Results indicate a complex pattern of mobility shifts over the past 1.5 million years in which alterations between mesic and xeric climatic regimes are the most important factor driving changes in site types and distributions.

**Keywords:** surveys, foragers mobility, lithic scatters, Paleolithic of Jordan, retouched tools, settlement patterns

### 1.0. Introduction

Chipped stone artifacts are nearly ubiquitous throughout most of the Middle East and Jordan is no exception. Virtually indestructible, they testify to a human presence in the region that extends back as far as 2.8 million years ago (Le Tensorer et al., 2015), coeval with the earliest known hominin range extensions out of Africa (Ferring et al., 2011). In Jordan, Oldowan sites from the Dauqara Formation (Zarqa) have recently been dated to 2.5-2.0 Ma (Scardia et al., 2019). Stone Age sites are frequently found on the deflated uplands of the Jordan *horst* where ancient sediments and soils have been stripped away by millennia of aeolian erosion. These surface finds typically pertain to the Lower (>2.5 Ma-250 ka) and, more commonly, Middle Paleolithic (250-40 ka) and are often wind-blasted, patinated, rolled and/or polished – evidence of long exposure to the elements. Buried Lower Paleolithic open sites with good faunal

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and floral preservation exist at a few localities (e.g., Gesher Benot Ya'aqov, in the Jordan Valley; Lion Spring in Jordan's Azraq Basin), and Middle Paleolithic sites in caves and rock shelters are well-reported from Israel (e.g., Tabūn, Kebara), Lebanon (e.g., K'sar Akil), Syria (e.g., Yabrud) and Jordan (e.g., Ain Difla, Tor Faraj). IUP/EUP transitional sites (~50-40 kya) have been identified at Boker and Boker Tachtit in Israel, and at Tor Sadaf and Mughr el-Hamamah, both in Jordan. Numerous Upper and Epipaleolithic (40-12 ka) sites are also known both in surface (e.g., Ain el-Buhayra) and rock shelter (e.g., Tor Hamar, Qafzeh) contexts, the latter sometimes stratified atop long sequences of earlier material (e.g., Qafzeh, Yabrud). Surveys since the 1980s have shown that open-air surface sites are more common than previously thought and far outnumber those in buried stratified contexts. Most surface sites consist only of lithics, however, and usually cannot be dated radiometrically. They are often viewed as limited in the potential for wringing behavioral information from them, but landscape approaches to survey data and a more sophisticated view of site formation processes are beginning to change that (see Bar-Yosef [1994], al-Nahar and Clark [2009], Shea [2013] for an overview of the Levantine Lower Paleolithic; Shea [2003], Bar-Yosef [2006] for the Middle Paleolithic; Goring-Morris and Belfer-Cohen [2003], Coinman [1990, 1995, 1998] for the Upper Paleolithic, and Neeley and Barton [1994], Neeley [1997], al-Nahar [2000] and Olszewski [2006] for the Epipaleolithic).

## 2.0. Methods and Materials

Deploying a novel methodology, this paper uses the incidence of retouched stone artifacts to assess the relative degree of mobility and duration of landscape occupation characteristic of Stone Age foragers in west-central Jordan based on random samples from the Shammakh-to-Ayl Archaeological Survey (SAAS) (MacDonald et al., 2016). These surface scatters are notoriously difficult to date and it is often next to impossible to determine whether or not they have any compositional integrity. The area surveyed was divided into three zones corresponding to natural phytogeographic, altitudinal and precipitation boundaries. Ten analytical units were defined and the artifacts collected were cross-classified by zone and by weathering, density, diagnostics and retouch indices in order to assess the strength of association among these variables and to determine to what extent strong associations corresponded to the zones identified by the SAAS survey team (**Table 1**). Time was considered a reference variable used to measure change attributed to other causes (that is, lithic technocomplexes do not change only because of the passage of time). The objective of the research is to determine the distribution of Stone Age artifacts in time and space and to make some assessment of the duration and nature of landscape (*not* site) use or occupation.

**Table 1. How the Random Square Data were Recorded.**

RS Number	RS 62				RS 67			
weathering index	heavy	medium	light	Total:	heavy	medium	light	Total:
number	0	7	23	30	18	20		40
percent	0	0.233	0.767		0.450	0.500		
no. diagnostic	0	0	0		4	1		
% diagnostic	0	0	0		0.800	0.200		
no. retouched	0	1	0		3	2		
% retouched	0	1	0		0.667	0.333		
RS density	0.112				0.160			
abrasion: diagnostics: retouched:			X	UP	X		MP	
				-	X		MP	
		X		MP	X		MP	
unimodal?					NO			
					YES			

The approach used here is somewhat controversial for several reasons. One is that most surveys use conventional techno-typological systematics to allocate assemblages to the various analytical units that comprise the Paleolithic. This research departs from that approach in that no a priori assignment to these units is made, and the incidence of retouched stone artifacts is taken to measure only the relative degree of mobility and duration of site occupation. In other words, it has nothing to do with social identity writ small in artifact form, the mental templates by which formal similarity is conveyed, nor lithic traditions passed down from one generation to the next. I discuss the rationale for the approach elsewhere (e.g., Clark and Riel-Salvatore, 2006), but it is based on solid evidence that – with very rare exceptions – all Stone Age sites are palimpsests, depositional composites that do not reflect the contemporaneous activities of any narrowly circumscribed group of people (see, e.g., Barton, 1991; Barton and Neeley, 1996; Clark and Barton, 2017). Put another way, no face-to-face interaction drives pattern in the coarse-grained time/space grid of the archaeology of ‘deep time.’

It should also be noted that, in respect of lithics, ‘site’ is often a misleading term because of the ubiquity of lithics in the landscape and because two kinds of data were collected by the SAAS survey teams: (1) 500 x 500 m (= 250,000 m<sup>2</sup>) squares (RSS) constituting a c. 5% systematic unaligned random sample of the total area surveyed (c. 590 km<sup>2</sup>), and (2) sites in the conventional sense of the term – lithic concentrations sufficiently dense and bounded to warrant separate designation. Whereas sites in later periods are well-bounded, often named localities in the landscape, almost always with architecture (e.g., Neolithic hamlets, Bronze Age farmsteads), paleolithic sites are poorly defined. They were

recorded in the RSS *and* in the areas adjacent to them if noted by the survey teams. Consequently whether or not lithic ‘sites’ are distinct from the background lithic scatter is arguable. Because of this methodological ambiguity, *lithic scatters recorded adjacent to later sites with architecture are omitted from this analysis*. The distribution of RSS is shown in **Figure 1**; the distribution of all archaeological sites (RSS + sites [sensu MacDonald]) is shown in **Figure 2**.

### 2.1. Weathering Index ( $\bar{x}_w$ )

To determine the predominant episode(s) of accumulation in a particular random square (RS), an index of weathering and abrasion was chosen to measure time independent of retouched and diagnostic pieces. The surface appearance of the artifacts was scored by the extent to which they were wind-blasted, patinated, rolled and/or polished under the assumption that – *on average* – heavily weathered pieces (H) should correspond to the Lower Paleolithic, moderately weathered ones to the Middle Paleolithic (M), and lightly weathered or ‘fresh’ pieces (L) to the Upper and Epipaleolithic (see Walwer [1993] for a negative view of this approach). The condition of the pieces is correlated with their relative ages and the length of time a particular spot in the landscape was revisited or utilized. For the archaeology of ‘deep time’, many studies have shown that an ‘archaeology of places and pathways’ is perhaps more realistic than an ‘archaeology of sites’ because the distributions of critical resources (e.g., springs in the arid Levant) are not well-bounded yet were revisited repeatedly over time resulting in artifact concentrations that were denser than those of the surrounding landscape (e.g., Gamble 1994). A Jordanian example is the Acheulean site cluster in the Azraq Basin, an oasis in the north-central part of the country surrounded by tens of thousands of square kilometers of waterless rock desert (e.g., Copeland and Hours 1989; Rollefson et al. 1997, 2006).

### 2.2. Density index ( $\bar{x}_D$ )

An index of artifact density ( $\bar{x}_D$ ) was also recorded (n/250) and means ( $\bar{x}_D$ ) calculated for RSS, individual zones, and for all three zones combined. Because artifact densities were always low relative to the area of the RSS, the density index was divided by 1000 and expressed as an exponent. Actual artifact densities for RSS are also provided in Clark (2016). This variable was intended to monitor overall occupation at different scales and for the survey area as a whole. More precisely, the ranked artifact density scaled to mean artifact density and zone area should identify the period best represented at each scale. It should also allow for comparisons with other surveys in areas adjacent to the SAAS (MacDonald 1988, 1992; MacDonald et al. 2004, 2012), elsewhere in Jordan (Miller 1991, Clark et al. 1992, Ji 2007, MacDonald 2007) and throughout the Levant (see Banning 2002 for survey methodologies).

### 2.3. Diagnostic Pieces ( $\bar{x}_3$ )

We also sought to take into account the conventional technological and typological criteria characteristic of Lower, Middle, Upper, and Epipaleolithic industries (**Table 2**). While considerable overlap between analytical units on both criteria has been well-documented for more than two decades, and the behavioral meaning assigned to pattern based on the diagnostics questioned, the diagnostic pieces themselves continue to serve as a *lingua franca* for preliminary descriptions and to facilitate communication amongst scholars from different research traditions. As was the case with the density index, means ( $\bar{x}_3$ ) were calculated for RSS, sites, zones, and for all three zones combined. Diagnostic pieces were used to assess the extent to which unit assignments made on the basis of the weathering criteria corresponded to those based on archaeological ‘index fossil’ tool types.

**Table 2. Lower, Middle, Upper, and Epipaleolithic Techno-typological Diagnostics in the Levantine Near East (from Bar-Yosef 1994, Chazan and Horwitz 2007, al-Nahar and Clark 2009, Shea 2013).**

<p><b>Lower Paleolithic</b> (Oldowan, Acheulean, Tayacian, Acheulo-Yabrudian)</p>
<p>Pebble, cobble and amorphous cores, disk cores (circular bifaces?); large massive, flakes and blades with unfacetted platforms, marked bulbs of percussion; unifacial choppers (cores?); bifaces (handaxes, cleavers, trihedrals (picks); spheroids, polyhedrals; large flake scrapers; truncated pieces; biface trimming flakes; Levallois technology rare or absent; artifacts large, massive</p>
<p><b>Middle Paleolithic</b> (Mousterian, Levallois-Mousterian, Hummalian)</p>
<p>Levallois cores, products (flakes, points, blades) common; single and multiple platform flake cores; disk (radial) cores; amorphous flake cores; cores made on large flakes; non-prismatic blades; straight and convex sidescrapers; Mousterian points (convergent scrapers); truncated facetted pieces; artifacts mostly made on flakes; facetted, dihedral striking platforms common; artifacts smaller, thinner</p>
<p><b>Upper and Epipaleolithic</b> (Emiran, Ahmarian, Levantine Aurignacian, Kebaran, Geometric Kebaran)</p>
<p>Single, multiple and opposed platform blade, bladelet cores; mixed flake/blade cores; crested blades; core tablets; prismatic blades, bladelets; microburin technique microliths (backed, pointed, truncated bladelets); carinated pieces; endscrapers; burins (dihedral, angle, multiple, on truncations); chamfered pieces; points made on bladelets; perforators, combination tools</p>

### 2.4. Retouch intensity index ( $\bar{x}_R$ )

A retouch intensity index ( $\bar{x}_R$ ) was computed to measure relative residential stability and to give some indication of the mobility strategies within which a particular site is embedded. A higher incidence of retouch indicates greater residential mobility, smaller groups, shorter duration of site occupation, low lithic densities, and many retouched pieces relative to *débitage* and cores. This configuration is expected to occur in xeric environments (e.g., Zone 3) where resources were ‘patchy’, irregularly distributed in the landscape, and less

predictable in terms of location. It is consistent with a strategy for provisioning mobile individuals with redundant, reliable, flexible, lightweight, polyvalent tool kits in order to minimize risk under conditions of uncertainty. Such assemblages have been described as ‘curated’ and are typical of the group fission phase in the driest seasons of an annual cycle (Binford 1979, Kuhn 1994).

Conversely, a high incidence of cores and *débitage* coupled with a low incidence of retouched pieces indicates a reduced need for conserving behaviors, greater residential stability, a longer duration of site occupation, and larger groups in mesic environments (e.g., Zone 2) where resource distributions are more predictable and when the locations of raw material sources are known and can be stockpiled in anticipation of future needs. Under these conditions, task groups would have been deployed from a residential base to acquire resources, logistical strategies would have been relatively easy to maintain, there would be little incentive to wring maximum utility from tool stones, risk would be minimized and mobility reduced (Clark 2016). Assemblages with these characteristics are often referred to as ‘expedient’ and signal group fusion during wet seasons and prolonged wet phases. Since topography and cyclonic patterns drive precipitation in the Near East, correlations between rainfall and altitude are also expected. Results indicate a complex pattern of mobility shifts over the past 1.5 million years in which alternations between mesic and xeric climatic regimes appear to be the most important factor driving changes in site types and distributions.

### 3.0. Phytogeographic Zones

The SAAS random sample was stratified by three zones based on vegetation type, elevation, annual temperature range, and precipitation. They correspond to and are extensions of the same zonal stratification used in the Ayl-to-Ras en-Naqb Archaeological Survey (ARNAS) immediately to the south (MacDonald et al., 2012). Westernmost Zones 1 (109 km<sup>2</sup>, 18.5% of the survey area, 1500-1200 masl) and 2 (123 km<sup>2</sup>, 20.8% of the survey area, >1700-1500 masl) have the highest average annual precipitation (c. 200-300 mm) and are covered in remnants of Mediterranean open park woodlands in which stands of pine, scrub oak, olive, pistachio, and *maquis* vegetation are important elements. Formerly continuous, these now-relict species are most prevalent in wadi beds and other protected locales. With higher rainfall dry farming is possible (olives, wheat) although pastoralism is also important in the local economy. In contrast, Irano-Turanian steppe vegetation (*Artemisia*, Chenopodiaceae) dominates in Zone 3 (358 km<sup>2</sup>, 60.7% of the survey area, 1500-1200 masl). There is very little arboreal vegetation (e.g., oleander, tamarisk, olives near springs and in wadi beds). Zone 3 is also very dry (<100–c. 50 mm). All three zones are used seasonally for transhumant pastoralism (sheep, goats) following corridors cut by E/W trending wadis. Pastoralism is the primary economic strategy in Zone 3; in the absence of irrigation farming is only practical on a very limited scale. The 1500 m contour between Zones 2 and 3 intersects an aquifer and a series of springs that support about a dozen villages, some of them extending as far back as the Pre-Pottery

Neolithic (e.g., Basta). Present in remote antiquity, they also served as focal points for hunter-gatherers during dry intervals in the Pleistocene. The distribution of Paleolithic RSS by phytogeographic zones is given in **Figure 3**.

## 4.0. Results

### 4.1. Zone 1

Zone 1 consisted of 12 RSS (4, 11, 39, 40, 43, 47, 57, 58, 63, 87, 102, 107). Due to difficulty in reaching the squares in the exceptionally rugged terrain, poor visibility due to ground cover, and units that yielded no lithics, only five squares (41.7%) produced quantifiable data.<sup>1</sup> Lithics were extremely sparse (n=51), with a very low mean density index ( $\bar{x}_D$ ) of 0.041 (=0.000041 pieces/RS). RSS 40 and 63 (Middle Paleolithic) were consistent across all three indices, as was RS 58 (Upper Paleolithic). RSS 39 and 107 were not, suggesting mixed assemblages so far as these units are concerned. A single unequivocal Lower Paleolithic piece was recovered, and despite the modern concentration of springs along the 1500 m contour line, there is little to indicate much LP use of the 1500-1200 m elevation band. MP concentrations are twice as common as UP ones, but sampled units are few and overall lithic densities extremely low. Sherds indicate a substantial Early Bronze, Roman, and Byzantine presence; Chalcolithic, Iron II, Late and Early Islamic pottery was also recovered. There are ancient and modern terrace walls throughout along with stone piles from field clearance, indicating cultivation in the past (only a very small part of RS 11 was planted with wheat at the time of the survey). Bedouin use the area today for late spring/early summer pasturage.

### 4.2. Zone 2

Zone 2 contained 26 RSS (1, 2, 10, 15, 16, 18, 19, 20, 22, 24, 27, 30, 31, 51, 54, 55, 62, 64, 67, 68, 70, 75, 80, 93, 103, 111). Lithic samples were collected from 21 squares (80.8%); RSS 2, 10, 22, 31 and 93 yielded no quantifiable data. Missing data are attributed to missing forms, no counts, no lithics collected, inaccessible sample units, and assignments based only on sherds (PN only). These units are not analyzed here. Lithics were comparatively rare (n=256), although twice as common as in Zone 1. The mean density index ( $\bar{x}_D$ ) was 0.081 (=0.000081 pieces/RS). RSS 15, 19, 27, 68 and 70 (Middle Paleolithic), and 20, 51, 54, 80 and 111 (Upper Paleolithic) were consistent across all indices; RSS 1, 16, 18, 24, 30, 55, 62, 64, 67, 75 and 103 were not, again suggesting no significant Lower Paleolithic use of the highest elevations in the SAAS (>1700-1500 m). The fact that MP and UP artifact concentrations are equally represented (5 each) could indicate roughly equal populations in Zone 2 over the long interval (c. 250-20 ka) represented by these analytical constructs. Examination of the survey forms shed little additional light on landscape use or occupation. Middle Paleolithic RS 15 yielded a number of 'classic' Levallois pieces; RS 27 also contained Levallois flakes, mixed flake/blade cores and a disk core, all patinated but 'fresh.' RS 18 shows evidence of reuse of MP artifacts by later (UP?) people as indicated by

sharp differences in both patination and abrasion, suggesting two distinct episodes separated by a considerable amount of time. Despite a few Levallois flakes and a point core, RS 30 is mostly post-MP. RS 64 has a classic Acheulean biface, an artifact type that disappears from the region after the Lower Paleolithic. Although mixed, the R 67 sample is a 'large' one ( $n=40$ ,  $\bar{x}_b=0.16$ ) contains some classic MP pieces (Levallois flakes, points), a high incidence of UP *débitage*, and a Chalcolithic circular scraper, prompting the survey team to suggest that it might be close to a source of raw material. This is one of the few RSS in Zone 2 that could be considered a site. Further investigation is recommended. Consistent across all indices, RS 68 is also dominated by MP pieces. Iron I and II, Nabataean, Roman and Byzantine sherds are present on those RSS that yielded lithics. Curiously, no Neolithic, BA or Islamic pottery was recovered. In contrast to the better-known Levantine coast, ceramics in the Pottery Neolithic, Chalcolithic and EBA are difficult to distinguish from one another, probably because of investigator bias in favor of the spectacular early history of the region. Sherds (mostly non-diagnostic plainware body sherds) are not very common on the numerous but mostly undated farmsteads that dot the landscape. Together with the de-emphasis on early ceramic sites, these are significant obstacles to the construction of ceramic typologies (Papalas 1997, Hill 2006).

### 4.3. Zone 3

Zone 3 is by far the largest in surface area, lithics recovered ( $n=2770$ ), and number of random squares (70), 96% of which yielded quantifiable data on chipped stone artifacts. Three random squares were consistent across all indices for the LP, 18 for the MP, and eight for the Upper/Epipaleolithic. Zone 3 contained 24 bimodal palimpsests, samples with approximately equal numbers of artifacts in two analytical units. They were about equally divided between LP/MP and MP/UP collections but these mixed collections were overwhelmingly dominated numerically by MP diagnostics. Collections from 16 RSS constituted trimodal palimpsests, again dominated by MP pieces. Upper Paleolithic collections were small and 'banal' in respect of diagnostics, underscoring the relatively sparse evidence for a human presence in Zone 3 from c. 45-20 ka. A large number of RSS were dominated by Lower and Middle Paleolithic diagnostics, and this was true regardless of whether or not index assignments were unimodal or multimodal. The collection as a whole is distinctly shifted 'back in time' compared to those from Zones 1 and 2, with wind-blasted, patinated, rolled and/or polished pieces highly correlated with Lower and Middle Paleolithic diagnostics. The higher incidence of earlier diagnostics can probably be explained by the extensive deflation characteristic of Zone 3. Artifacts originally deposited on long-gone land surfaces accumulated in particular places in the modern landscape as a consequence of aeolian erosion that concentrated artifacts from different time periods vertically but left their horizontal distributions relatively intact.

#### 4.4. The Lower Paleolithic ‘signal’

The three random squares with a strong Lower Paleolithic ‘signal’ (79, 82, 92) are unique in the SAAS context, and in the adjacent ARNAS (MacDonald et al. 2012) and TBAS (MacDonald et al. 2004) surveys. All are located in gently rolling terrain in the northeast third of Zone 3 in deflated uplands at around 1300 masl. Although isolated finds of bifaces have been reported from many localities in west-central Jordan, few convincing Acheulean sites are known in that region (see al-Nahar and Clark [2009] for a discussion of LP sites in Jordan). The single exception is Fjaje, located some 25 km north of the SAAS survey area. An enormous linear scatter of Late Acheulean artifacts, the site extends for about 20 km overlooking the Wadi Bustan near the Crusader fortress of Shobak. Discovered by Gary Rollefson in 1981, it comprises the remains of thousands of individual campsites accumulated along the wadi banks over tens of millennia. Rollefson (1981, 1985) suggested that the escarpment at Fjaje might have been used to monitor the seasonal movements of gregarious herbivores (e.g., gazelle) as they passed through the Wadi Bustan from the warmer, more heavily vegetated Wadi Arabah lowlands to the western highland savannas during the spring migration. Confined to the wadi bed, they would have been relatively easily ambushed by hunters waiting along the rim. Something similar might have occurred in Zone 3, although the wadi systems there are less heavily dissected (thus less well-suited for confining the movements of herds of animals). That said, the same kind of E/W migrations are known to have taken place in the region historically (Henry 1994).

As was the case with Zone 2, evidence of reworking of Lower and Middle Paleolithic artifacts was noted in about a dozen sample units. It suggests repeated albeit episodic visits to particular places in the landscape over very long periods of time. Evidence of reworking is moderately correlated with RSS within about 3 km of the 1500 m contour line, an elevation that appears to intersect an aquifer as indicated by the presence of many springs. Although more or less active depending upon macroclimate and local hydrology, those springs probably attracted humans for millennia, resulting in artifact concentrations that were subsequently appropriated by later people throughout the Stone Age.

#### 5.0. Incidence of Retouched Pieces

Regarded here solely as a measure of relative mobility (Riel-Salvatore and Barton 2004, Miller and Barton 2006), the retouch index ( $\bar{x}_R$ ) is computed by dividing the total number of retouched pieces by the total number of artifacts in each abrasion category ( $\bar{x}_{RH}$ ,  $\bar{x}_{RM}$ ,  $\bar{x}_{RL}$ ). The grand mean ( $\bar{x}_R$ ) is computed summing the individual category totals ( $\bar{x}_{RH}$ ,  $\bar{x}_{RM}$ ,  $\bar{x}_{RL}$ ) and dividing by the total number of retouched pieces ( $\bar{x}_R = \sum n_{i=3} / N_{j=3}$ ).

In Zone 1,  $\bar{x}_{RH}$  is zero,  $\bar{x}_{RM} = 0.294$ , and  $\bar{x}_{RL} = 0.030$ ; the Zone 1 grand mean is 0.118. In Zone 2,  $\bar{x}_{RH} = 0.250$ ,  $\bar{x}_{RM} = 0.113$ , and  $\bar{x}_{RL} = 0.095$ ; the Zone 2 grand mean is 0.109. In Zone 3,  $\bar{x}_{RH} = 0.103$ ,  $\bar{x}_{RM} = 0.155$ , and  $\bar{x}_{RL} = 0.104$ ; the Zone 3 grand

mean is 0.126. If these statistics are ranked from 1 to 3 (1= most retouch, 3 least) and summed by abrasion class, Middle Paleolithic artifacts are most intensively retouched; Lower and Upper Paleolithic are tied. Adjusted for the area of each zone, the corresponding statistics for retouch incidence in Zone 1 (109 km<sup>2</sup>) is 1.08<sup>-3</sup>/km<sup>2</sup>; for Zone 2 (123 km<sup>2</sup>) 8.86<sup>-4</sup>/km<sup>2</sup>; and for Zone 3 (358 km<sup>2</sup>) 3.52<sup>-4</sup>/km<sup>2</sup>. While small sample size in Zone 1 precludes analysis (thus disregarded), the values obtained for Zones 2 and 3 are consistent with the corresponding density statistics. Zone 2 is most consistent with the provisioning of mobile individuals. Correlates of large amounts of retouch are (1) less residential stability, (2) a shorter average duration of site occupation, (3) strategic mobility (i.e., no long-term residential bases, little or no task group deployment, more frequent moves by the whole band), and (4) relatively little reworking of tools. These patterns would be expected to occur during (5) cool/cold, dry climatic episodes (MIS 6, 4) that would have been most extreme in highland Jordan. Zone 3, on the other hand, is counterintuitive in terms of expectations under the model. While extremely dry today, it seems to represent a region of greater residential stability consistent with place provisioning. A lower incidence of retouch is correlated with (1) residential stability, (2) longer duration of site occupation, (3) logistical mobility (i.e., deployment of task groups from a residential base for resource procurement) and (4) more reworking of tools. These patterns typically characterize (5) relatively warm, wet climatic conditions, perhaps indicating most intensive occupation during MIS 5 and 7 when the region was dotted with shallow lakes, marshes and springs. In other areas of the Levant (e.g., in the Central Negev highlands) these patterns are supported empirically by extensive archaeological survey and excavation, geoscience research, and paleoclimatology (e.g., Marks and Freidel 1977, Horowitz 1979, Goldberg and Macphail 2008, Courty et al. 1989, Cordova 2007).

## 6.0. Implications for mobility

So far as retouch and its implications for mobility are concerned, the data are not so easily interpreted. If the unscaled grand means for  $\bar{x}_{RH}$  are ranked from highest to lowest, the MP in Zone 3 emerges as the most intensively retouched analytical unit. This would imply less residential stability and more transient camps in the eastern half of the survey and the provisioning of individuals characteristic of strategic mobility. Zones 1 and 2, with lower indices, would tend to indicate more stability consistent with the provisioning of places. However, when these statistics are adjusted to take the area of each zone into account, the ranking changes so that Zone 2, the montane uplands of the Jabal ash-Sharah, is ranked first, followed by Zones 3 and 1.

## 7.0. Climate data

When the climate data are added to the mix, they suggest that MP aggregation

sites would have been located in the well-watered, cooler, resource-rich uplands, probably during the summer months when most of Zone 3 would have been hot, dry and inhospitable. In the winter, MP foragers would have dispersed into small groups, moving as independent residential units as they descended to the steppes to avoid the cold at higher elevations. This pattern would have been typical of MIS 7 (242-186 ka) and 5 (121-71 ka – both warm), with a possible reversal during MIS 6 (186-127 ka) and 4 (71-57 ka – both cold). Whatever the case, there are precedents for this kind of seasonally mediated forager transhumance that Donald Henry (1994), using data from the south edge of the Jordan Plateau, believes to have been of great antiquity.

### 8.0. Frequency distribution

The frequency distribution of SAAS random square means by analytical units for Zones 1-3 is shown in **Figure 4**. The extremely low frequencies of the later analytical units (Epipaleolithic to Pre-Pottery Neolithic) can be explained by the near invisibility of these tiny microlithic artifacts except in site contexts where architecture is present and/or there is sustained, long-term occupation. Epi/PPN sites almost certainly exist in the SAAS survey area but none were detected by the sampling design adopted here. It is interesting to note that the lithic collections from the ARNAS survey produced a very similar pattern, and probably for the same reasons (Clark 2012).

### 9.0. Conclusions

To summarize research conclusions, analysis of the lithic component of the SAAS survey showed that there was relatively good correspondence between the three indices and fair-to-good segregation amongst the analytical units by zone. Despite the statistical utility of a systematic, unaligned random sample, various problems with the approach surfaced, notably a very small sampling fraction (c. 1.2%, *vis à vis* c. 5% for the survey as a whole) and what constitutes a site (only the random square data were analyzed here). Zone 1 was heavily eroded; few lithic scatters were detected. Three large Lower Paleolithic scatters (and three RSS with large LP/MP components) were identified in the northeast third of Zone 3. No similar concentrations were located in the MacDonald's other west-central Jordan surveys (WHS, TBAS, ARNAS, SGNAS). the strongest 'signal' was that of the Middle Paleolithic (250-40 ka). MP use or occupation was consistently better documented than that of the Lower and Upper Paleolithic. This is particularly evident in the best sample, the RS data from Zone 3: seven of eight RSS with  $\bar{x}_o > 0.300$  were Middle Paleolithic. Although the low resolution of the SAAS lithic data base urges caution, our analyses are consistent with a sustained, albeit fluctuating, MP presence, a finding corroborated elsewhere in west-central Jordan and in Palestine. MP sites are scattered across all three zones but are most prevalent in the southern third of Zones 2 and 3. The MP collections from Zone 3 were also the most intensively retouched, suggesting a relatively high incidence of

overnight camps with curated assemblages. MP and UP residential bases with expedient assemblages were few and mostly confined to the Jabal ash-Sharah in Zone 2, perhaps indicating summer aggregation at higher, cooler elevations with more reliable water sources. UP scatters in the western part of Zone 3 are aligned with a series of springs along a fault line, some still active today. Although radiometric dates in Jordan are relatively few, and faunal assemblages scanty, many MP sites probably date to the warm, wet MIS 5 (127-71 ka BP), marked by expansion of East African grasslands and fauna. Nearly absent are Epipaleolithic and PPN scatters, almost certainly because of low visibility and the coarse 'grain' (low resolution) of the survey data. Epipaleolithic and Prepottery Neolithic sites are well documented in the adjacent surveys (e.g., Olszewski 2006; al-Nahar and Olszewski 2015).

### 9.1. Epilogue

The SAAS collections are typical of those resulting from the large scale, coarse-grained surveys that MacDonald directed over his long career (Clark 2017). The primary objective was to locate, describe and date architectural features (e.g., houses, farmsteads, hamlets, villages, roads, mills, cisterns, corrals, watch towers, etc.). The earliest surveys had neither sampling designs nor precise methods for site location, nor were they needed, given that architectural sites were the primary objective. Sites were simply plotted on 1:25000 and 1:50000 Royal Geographic Survey topographic sheets. Map references, elevations, site types, descriptions, chronology (18 periods, 28 subdivisions based on diagnostic lithics, ceramics), and site function were included from the start (WHS, 1979-1983), supplemented by topography, a history of exploration and recent economic developments (land use) in SGNAS (1985-1986). As time went on, geomorphology, water sources, vegetation and paleoclimate data were added to the methodological repertoire (TBAS, 1999-2001), followed by systematic unaligned random sampling and GPS in the ARNAS (2005-2007) and SAAS (2012-2012) projects.

Analyzing the SAAS lithic collections according to the approach outlined above revealed both strengths and weaknesses. On the positive side, the weathering and abrasion index worked about as well as diagnostic artifacts and was quicker to use when faced with large samples. The density index worked well to determine areas of concentrated human activity. The approach was successful in locating quadrats with good Lower (rare) and Middle Paleolithic samples (common – the latter verified by work in Palestine and the Sinai). The random samples are useful for future research. Perhaps most important, it demonstrated the value of a landscape-based (rather than a site-based) approach.

On the negative side, the data were too coarse-grained to better document mobility strategies (not enough retouched pieces), temporal resolution could not be refined beyond major C/S units, the quadrats were too large given the size of the survey teams, sample size per quadrat and the overall sample fraction (c. 1.5%) were too small, the best of the index statistics (the tri-variate comparisons) were not robust (better results were obtained with the bi-variate ones), Epipaleolithic

and PPN scatters were certainly present but went undetected, and the expertise of the survey teams regarding 'lithic archaeology' varied from one season to the next.

More can be done, of course – more can *always* be done when it comes to archaeology! Lithic technology and mobility strategies are fairly direct indications of the ways humans interacted with their environments. By combining the appropriate research strategies, we should be able to identify land forms with specific characteristics that were utilized heavily, moderately, lightly or not at all over a changing succession of paleoclimates. It is reasonable to expect that optimal combinations of slope, aspect, distance to water, etc. existed for foragers at any given interval over the 1.5 million years since the earliest hominids expanded their ranges to enter the Levant for the first time. When these optimal conditions deteriorated because of climate change and/or the population-resource imbalances characteristic that ensued from them, foragers would have been compelled to adjust their notions of acceptable habitat to include resource patches previously ignored or underutilized. All survey data in deep time are inevitably exceptionally 'coarse-grained,' far removed from their original depositional contexts (UCLA archaeologist James Sackett [1991] famously described this phenomenon as "landscapes of loss and discard"). Rather than pursue the discovery of the 'little Pompeiis' that have been the object of much archaeological research, we need to learn how to wring more behavioral information out of the spatially extensive but contextually impoverished artifact scatters that we do have. With GIS methodologies and the powerful computers and statistical routines that support them (e.g., Neteler and Mitasova 2008), we might be able to overcome some of the more stringent limitations of the survey in 'deep time.'

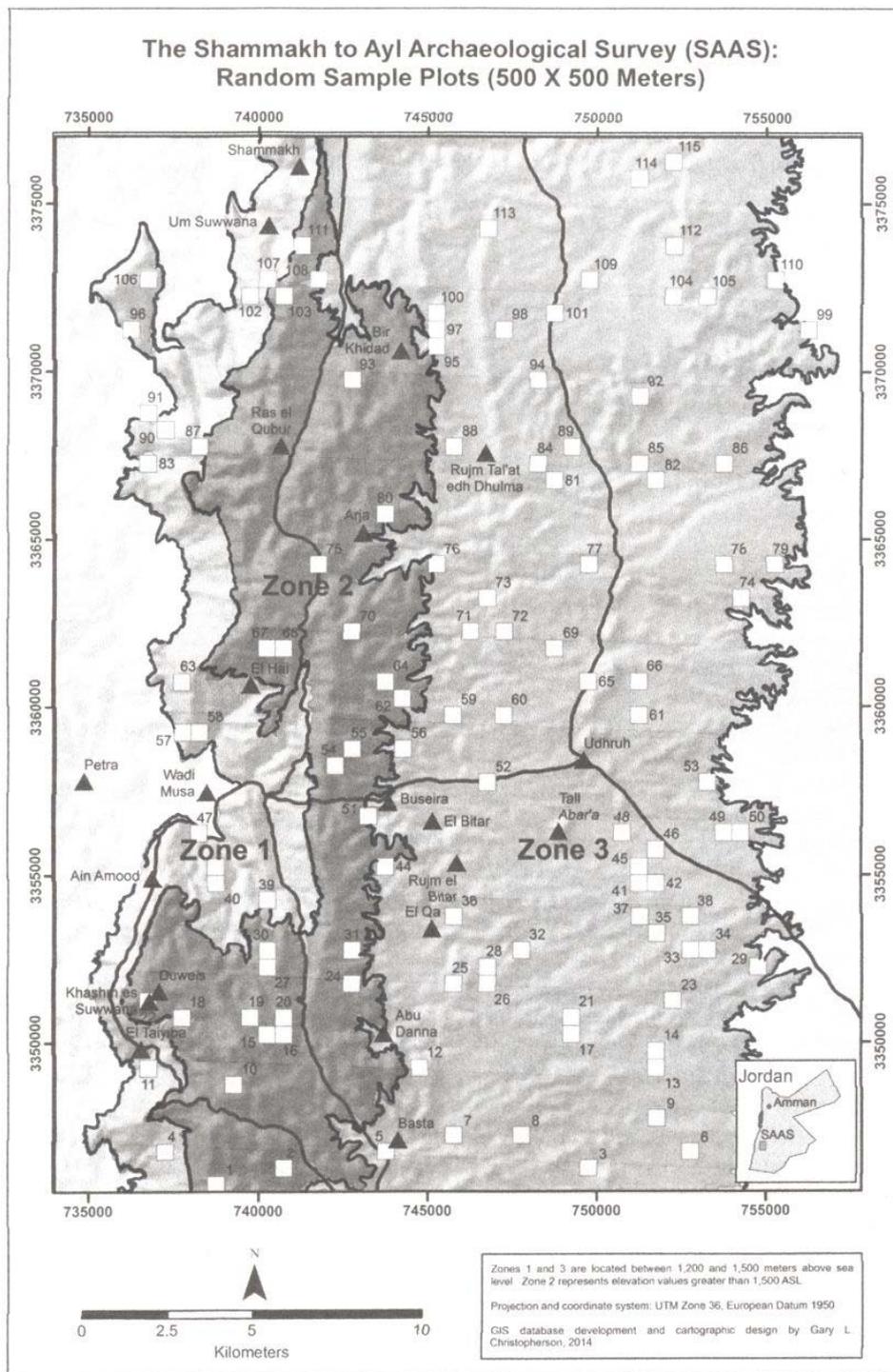
Burton MacDonald is a man of many parts. To his enduring credit, he included Paleolithic archaeologists on his survey teams and research projects even though his special areas of expertise extended across Roman, Nabataean and Byzantine studies, Biblical archaeology, and the history and archaeology of the Islamic caliphates. Stone Age Jordan was never a primary concern. But without his breadth of vision, kindness, generosity, organizational skills, financial and moral support, none of the Stone Age research reported here would have been possible.\*

### **Acknowledgments:**

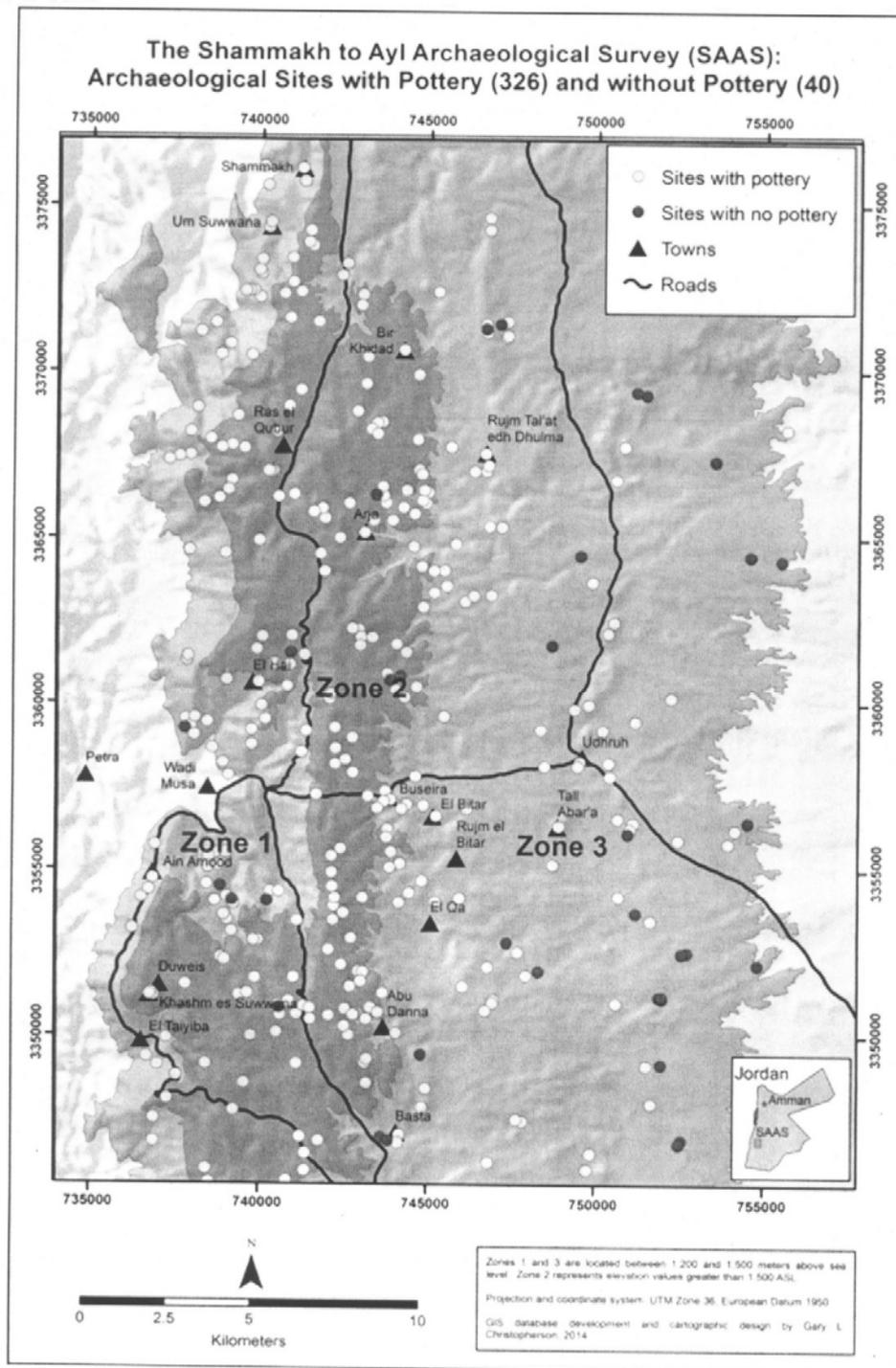
This research would not have been possible without the generous support of the Social Sciences and Research Council (Canada), St. Francis Xavier University (Canada), Arizona State University (USA), the American Schools of Oriental Research (USA) and the Department of Antiquities (HKJ). In particular, the former Directors General of the Department of Antiquities, granted permission to conduct the work in 2010 and 2011. We also thank our DoA representatives Ashraf al-Khraysheh and Sate Massadeh, and the staff of the DoA who facilitated work in the field and in publication. Gary Christopherson compiled the GIS database and prepared Figures 1-3.

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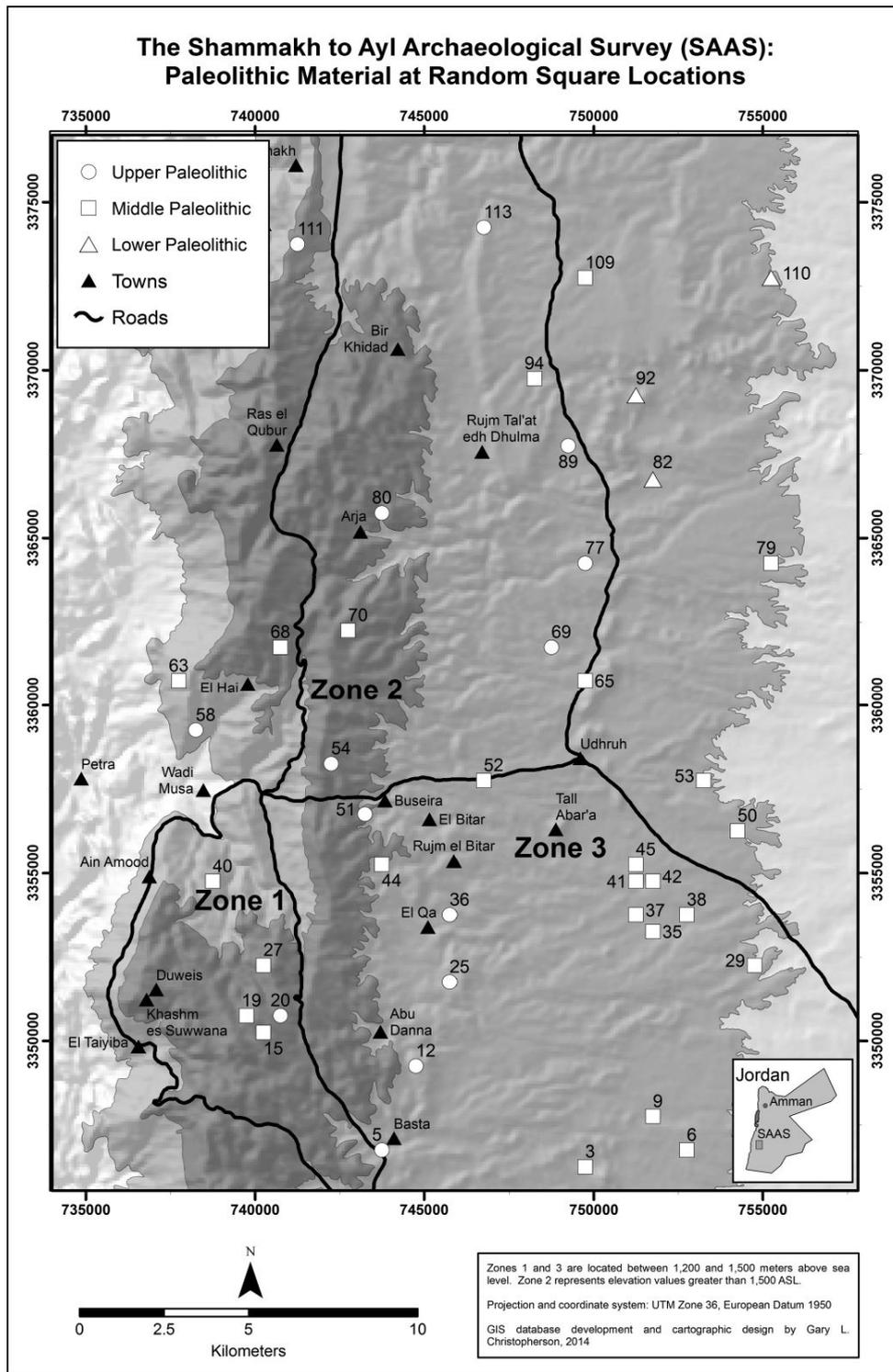
\* Endnote 1: Primary data used here are given in Clark (2012b, 2016b).



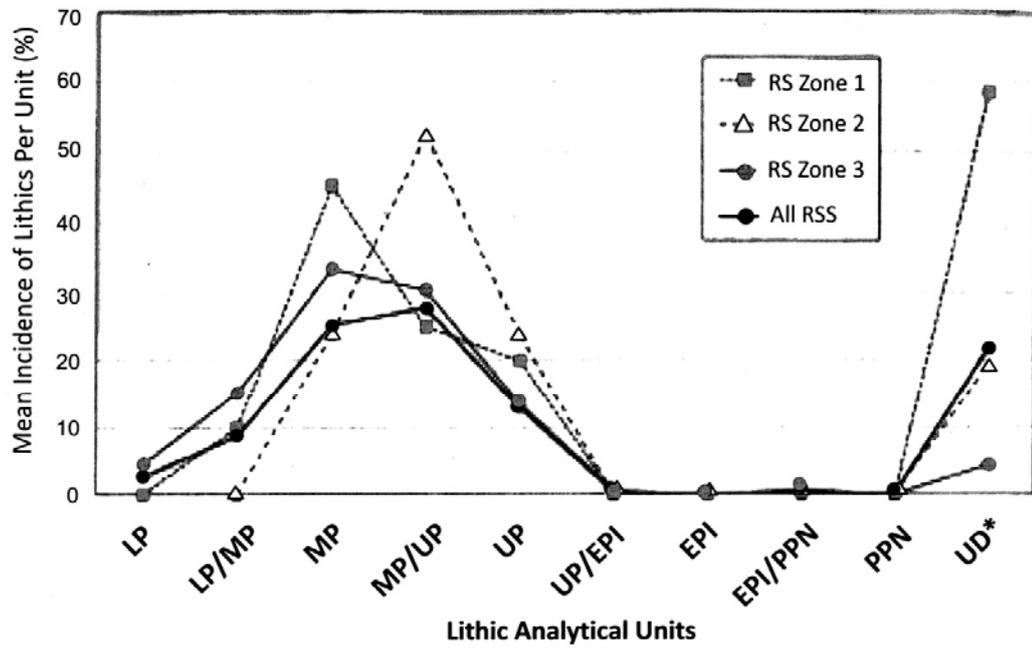
**Figure 1. SAAS Zones 1-3: Random squares (RSS) by phytogeographic zones (modified from MacDonald [2016: 2]).**



**Figure 2. SAAS Zones 1-3: Archaeological sites with and without ceramics. Note the high density of Pottery Neolithic and Metal Age sites in Zones 1 and 2 and their relative scarcity in Zone 3 (from MacDonald [2016: 480]).**



**Figure 3. SAAS Zones 1-3: Lower, Middle and Upper/Epipaleolithic sites that are consistent across all indices (from Clark [2016: 462]).**



UD\* = undiagnostic (% of the RS total by zone that could not be assigned to an analytical unit. For example, Zone 1 has 12 RSS, but only 5 of them (41.7%) yielded quantifiable data. Seven (58.3%) could not be assigned To an analytical unit.

Figure 4. SAAS Zones 1-3: Random square mean frequencies by analytical units (from Clark [2016: 460]).

## تنقل الطوافين في مرتفعات وسط -غرب الأردن خلال فترة البلايستوسين

جفري كلارك\*

### ملخص

يناقش هذا البحث تنوع درجات ومدد إقامة الطوافين في منطقتي وسط الأردن وغربه خلال العصور الحجرية القديمة، اعتماداً على البيانات الإحصائية الخاصة بتشذيب الأدوات الصوانية، من حيث إن التشذيب يمكن أن يُستخدم مقياساً لأنواع الاستقرار البشري وكميات الأدوات الصوانية وطرائق تشكيلها في مواقع العصور الحجرية؛ إذ إن الكثافة العالية للأدوات المشدبة في الموقع الأثري تشير إلى أن عدد أفراد المجموعة البشرية قليل وتقلهم كثير، كما أن وجود كميات قليلة من تلك الأدوات يشير إلى أن مدة الإقامة كانت قصيرة، وقد استخدم هذا النمط من استراتيجيات التنقل في فترات الجفاف، أما إذا ظهرت كميات كبيرة من الأنوية والمجاميع الصوانية في الموقع مع عدد قليل من الأدوات المشدبة فإن ذلك يعد دليلاً على استقرار مجموعة بشرية كبيرة مدة طويلة في الموقع. علماً أن هذا النمط ترافق مع فترات المناخ الرطب؛ حيث تتوفر مصادر الرزق المختلفة وتكون مصادر الصوان معروفة. وقد استنتجت هذه المعلومات من دراسات أجريت لخمسة أقسام فرعية من العصر الحجري القديم مقابل ثلاثة مناطق جغرافية بيئية، بينت وجود نمط معقد من استراتيجيات تنقل الإنسان على مدى 1.5 مليون سنة الماضية، التي تُعد فيها التغييرات المناخية أهم عامل مؤثر قاد إلى تنوع المواقع وتوزيعها.

**الكلمات الدالة:** المسح الأثري، تنقل الطوافين، العصور الحجرية القديمة في الأردن، الأدوات الصوانية، التشذيب، انماط الاستقرار البشري.

\* جامعة ولاية أريزونا، الولايات المتحدة الأمريكية. تاريخ استلام البحث 2020/1/5م، وتاريخ قبوله للنشر 2020/2/5م.

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