

# The Late Neolithic colonization of the Eastern Badia of Jordan

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Pioneering research by Betts and by Garrard in the eastern steppe and desert of Jordan demonstrated the presence of Late Neolithic (c. 7000–5000 cal BC) pastoral exploitation of this currently arid/hyper-arid region, but the scale of Late Neolithic presence in the area was difficult to assess from the reports of their surveys and excavations. Recent investigations by the Eastern Badia Archaeological Project at Wisad Pools and the Wadi al-Qattafi in the Black Desert have shown that conditions during the latter half of the 7th millennium and into the 6th, permitted substantial numbers of pastoralists to occupy substantial dwellings recurrently, in virtual village settings, for considerable amounts of time on a seasonal basis, relying heavily on the hunting of wild animals and perhaps practising opportunistic agriculture in addition to herding caprines.

**Keywords** Late Neolithic, pastoralism, architecture, palaeoclimate, caprines

## Introduction

2 The middle of the 8th millennium in the southern Levant witnessed considerable turmoil: substantial numbers of Middle PPNB settlements in the Jordan Valley and areas to the west were abandoned, and large numbers of people migrated to the Jordanian highlands, resulting in the growth of local villages such as ‘Ain Ghazal and Wadi Shu’eib to ‘megasite’ status, as well as the founding of other enormous megasites including Basta, as-Sifiya, ‘Ain Jammam, among others (Rollefson 1989, 1997, 2005; Mahasneh 1997; Waheeb and Fino 1997; Simmons *et al.* 2001; Gebel *et al.* 2004). The resulting large populations in these Late PPNB population centres imposed unprecedented pressure on local resources, including farmland and pasturage, during the last half of the 8th millennium, a stress that was critically exacerbated with a major drop in annual precipitation by c. 7000 cal BC (Migowski *et al.* 2001: fig. 4; Bar-Matthews and Ayalon 2004: fig. 9-c; Mayewski *et al.* 2004: fig. 1-o).

The combination of high demands for farmland and pasturage on unstable resources resulted in drastically reduced populations at some of the sites (e.g. ‘Ain Ghazal and Wadi Shu’eib) and the outright abandonment of other population centres. With population estimates ranging into the thousands for some of the LPPNB megasites (Rollefson and Pine 2009), there was a subsequent reversal of the situation that originally led to the emergence of the megasites: large numbers of residents relocated elsewhere, although it is not clear where the destinations were.<sup>1</sup> One likely territory was a region whose climatic conditions were inimical to agriculture: landscapes that could not support perennial farming because of a lack of reliably sufficient rainfall, but whose phytogeographic cover could be converted into energy and other requirements through the agency of the herding of caprines. By the first half of the 8th millennium cal BC goats had been domesticated in the southern Levant (von den Driesch in Horwitz *et al.* 1999: 71; Wasse 2000; Martin and Edwards 2013: 73), and sheep were introduced into the area at the end of the first half of the 8th millennium (von den Driesch and Wodtke 1997; Martin and Edwards 2013: 64). While ‘pastoralism’

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<sup>1</sup>Surveys in Syria and Lebanon do not appear to reflect a significant increase in site numbers or site sizes in the early 7th millennium cal BC.

is a term that has many nuances of meaning, its foundation is the management of domesticated animals (Makarewicz 2013: 160), a practice that began in the late 9th and early 8th millennia cal BC and developed in terms of increasing intensity and extensive territorial range.

The emergence of pastoral nomadism/transhumance in eastern regions of Jordan and Syria unsuited to agriculture may have begun as early as the final century of the Late PPNB or the PPNC, based on faunal remains from Bawwabah al-Ghazal, a small hunter-herder camp in the Azraq region (L. Martin, personal communication; cf. Rollefson *et al.* 1999) and sites in Wadi Jilat and South Azraq (Martin and Edwards 2013: 69). Evidence of a dual nature of structures at early 7th millennium (PPNC) 'Ain Ghazal has been interpreted as indicative of a bifurcated subsistence economy: as a form of 'tethered pastoralism', part of the resident population took the settlement's caprine herds into the arid regions during the rainy

season when steppe/desert terrain burgeoned with temporary vegetation and water sources, just at the time crops were growing in the farming areas of the west (Köhler-Rollefson 1988; Rollefson and Köhler-Rollefson 1993). Other researchers have also concluded that the turn of the 8th/7th millennia may have witnessed an increased pastoral exploitation of today's steppe and desert region (Garrard *et al.* 1994a: 188; Betts 2013: 188–89).

As will be discussed in greater detail below, the initiation of systematic investigations of the currently uninviting landscapes of eastern Jordan were made in the late 1970s and 1980s by Garrard and Betts. Their surveys and excavations demonstrated the presence of social groups in today's steppe and even in the hyper-arid desert. As groundbreaking as their research was for this region, due to the limited area that they investigated (in relationship to the overall arid regions), the results of their research suffered to some degree from sampling problems. The

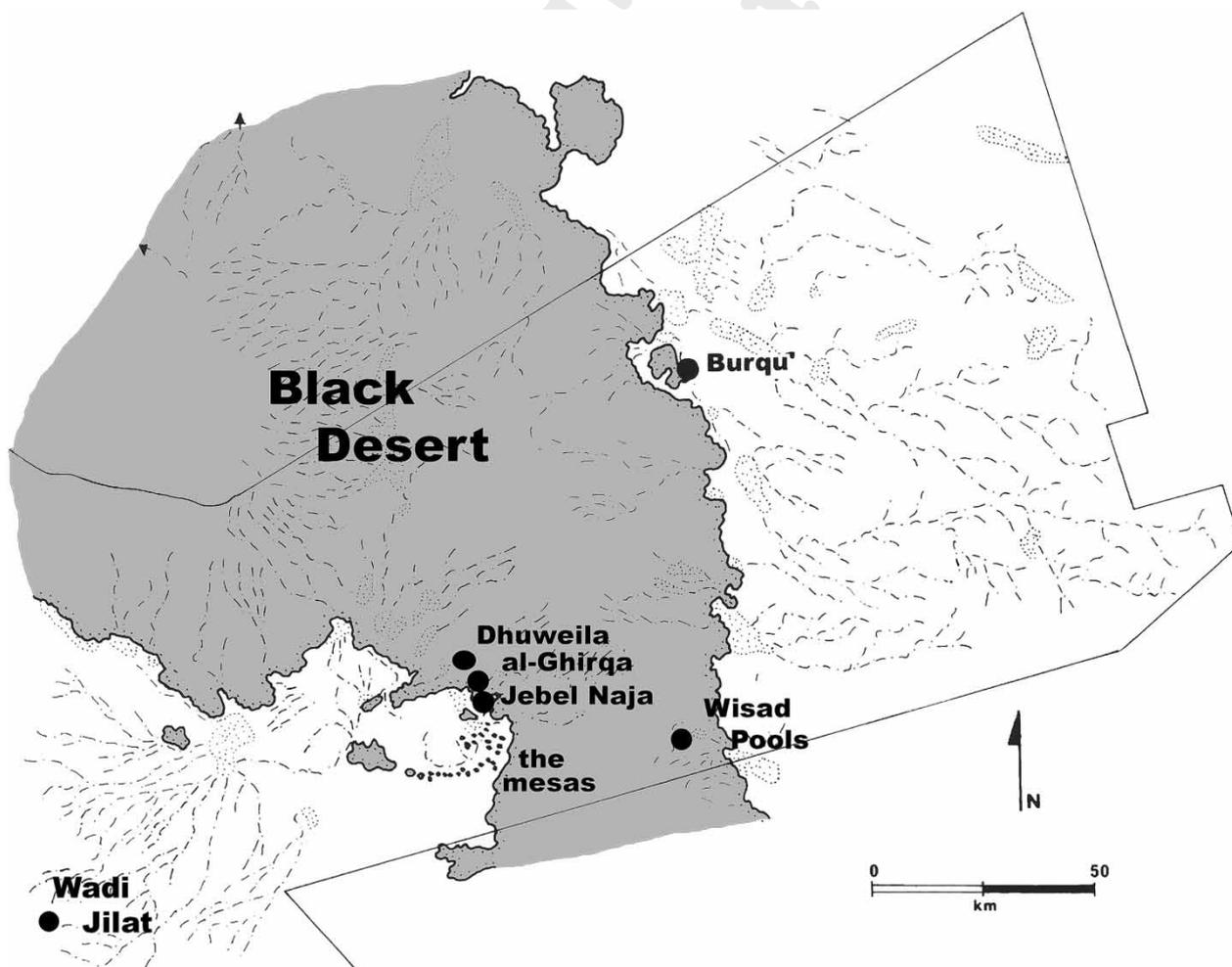


FIGURE 1 Location of sites discussed in and near the basalt desert (shaded). After Betts 2013: fig. 1.2

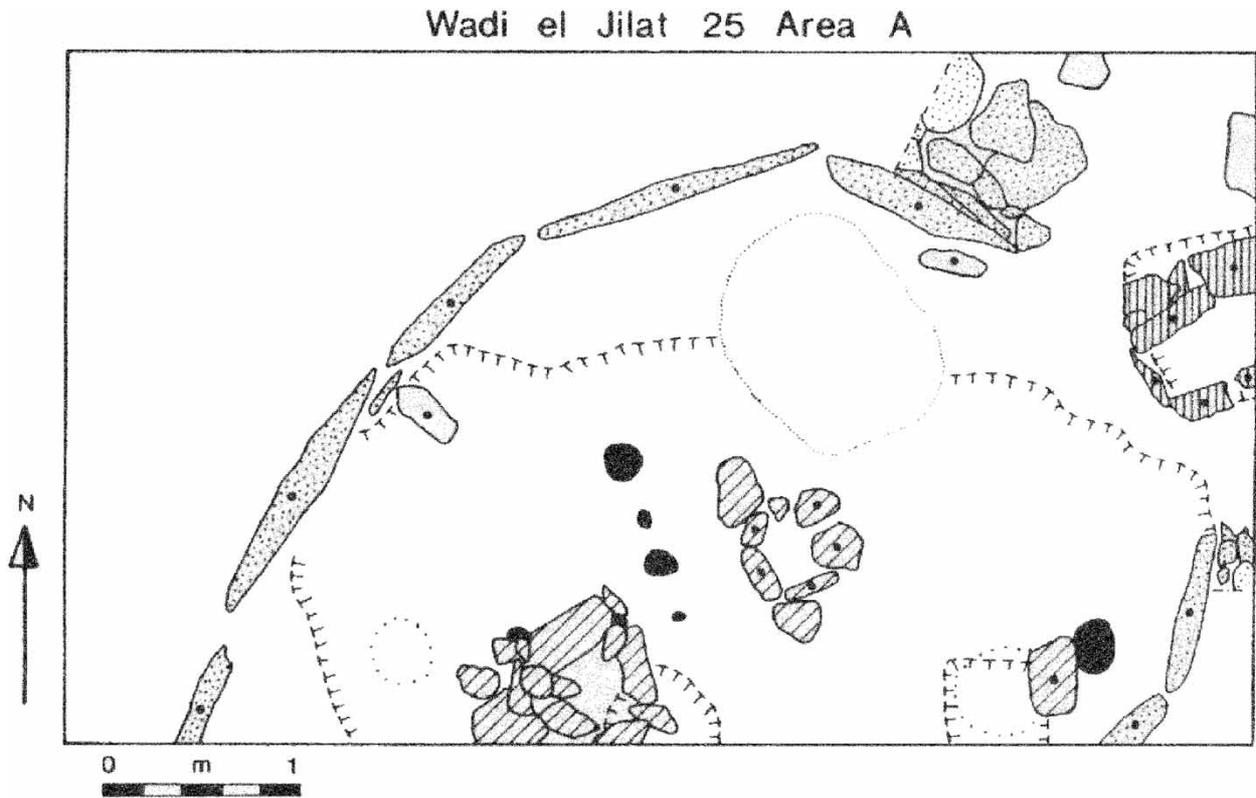


FIGURE 2 Plan view of Late Neolithic house at Jilat 25.  
After Garrard et al. 1994b: fig. 6b.

impression gained from their results was one of low-level, almost timid experimentation in the region by small groups, an interpretation that lend support to the suggestions by Byrd and Martin that the Late Neolithic herders were former local hunter-gatherers who added a novel element to their subsistence economy (Byrd 1992: 55; Martin 1999: 96). As we shall explain below, based on our recent research in

at the mesas in Wadi al-Qattafi and at Wisad Pools in the Black Desert (Fig. 1), both suggestions are probably incorrect (or at least insufficient), and that the Late Neolithic colonization of the Badia was by a substantial number of mobile hunter-herders who had recently descended from dislocated families from the agricultural territories in western Jordan and Syria.

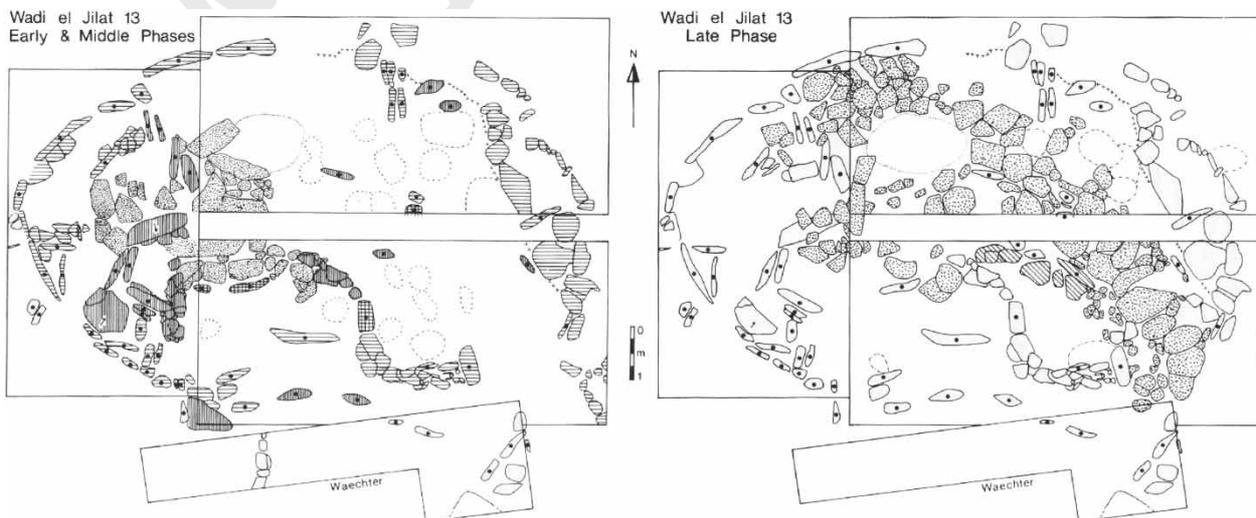


FIGURE 3 Plan of Late Neolithic house phases at Jilat 13 (after Garrard et al. 1994b: fig. 5c,d).

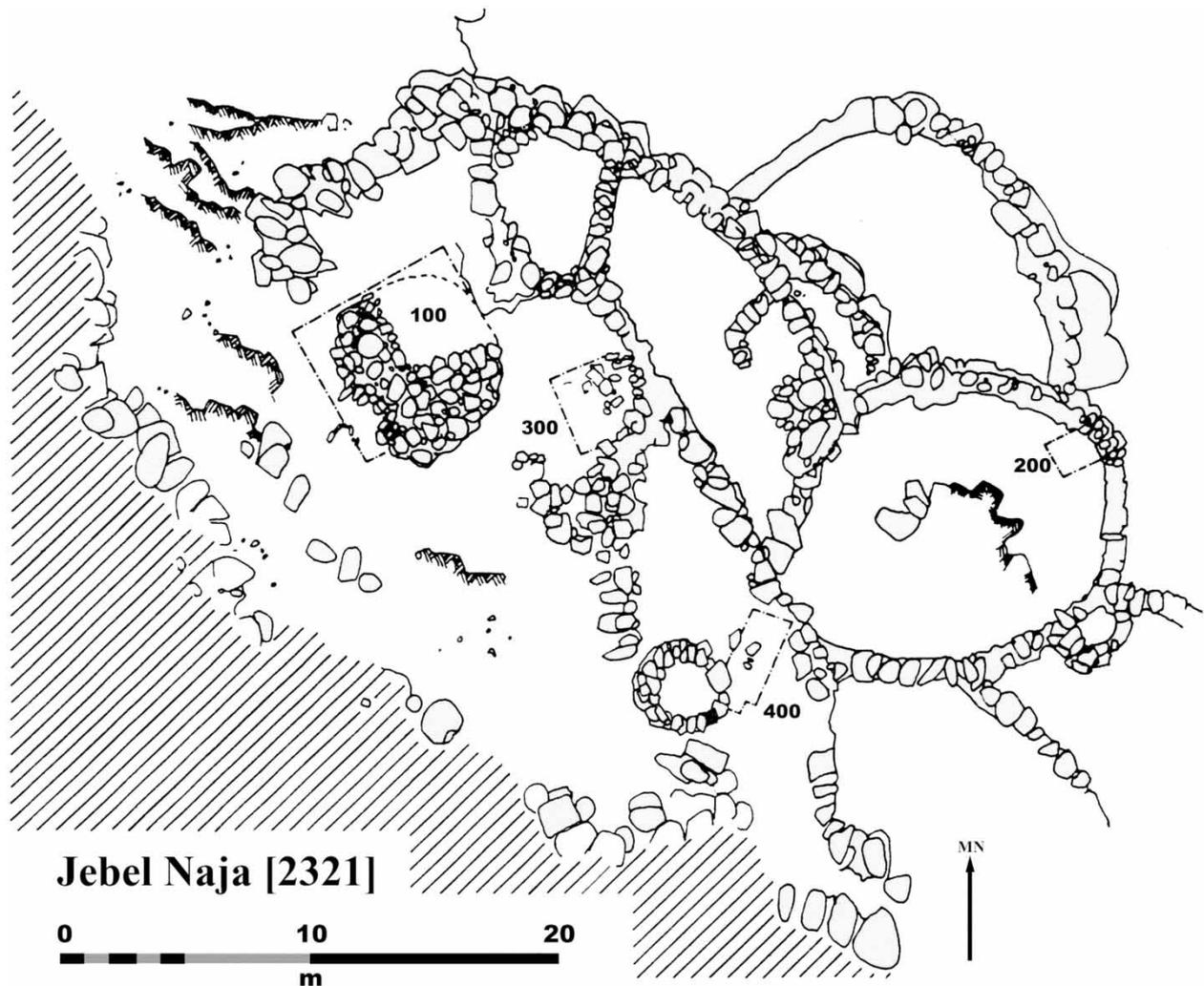


FIGURE 4 Plan of Late Neolithic camp at Jebel Naja (after Betts 1985: fig. 16).

### The state of research in the Badia in the 1990s

The survey of the Azraq Basin in 1975 by Andrew Garrard (Garrard and Stanley Price 1975–1977) was the first systematic exploration of a region of the Badia. Although earlier non-systematic investigations had been undertaken as early as the 1920s (Field 1960) and in the 1930s by Waechter and Seton-Williams (1938), Garrard and his team demonstrated that Neolithic activity in the Wadi Jilat (Fig. 1), which today cuts through a rolling steppe landscape (<200 mm annual rainfall; for the Wadi Jilat the average is between 100 and 200 mm per year [Sajdi 2011]) began in the Early PPNB (c. 8500 BC) at the site of Jilat 7. PPNB settlements in the Wadi Jilat and the Azraq Basin may, in view of the presence of domesticated cereals and grinding stones, have been agricultural communities (Garrard *et al.* 1994a: 193–96), a possibility in this currently arid territory if early Holocene rainfall was significantly higher

than today (Bar-Matthews and Ayalon 2004: 381 and figs 9-c and 12). Notably, PPNB sites had several structures suggesting that multiple families inhabited them concurrently. By the Late Neolithic (hereafter LN, including the PPNC period of the western regions of Jordan), sites consisted of single dwellings that had increased in size (Figs 2 and 3), perhaps reflecting either larger residential groups or structures that housed both people and animals (Garrard *et al.* 1994a: 185). While it is unclear if caprine herding was practised here during the Late PPNB, the faunal remains from PPNC/Early Late Neolithic sites indicate that pastoralism was underway from the beginning of the first half of the 7th millennium cal BC (Garrard *et al.* 1994a: 188; Martin and Edwards 2013: 73), supporting the prediction by Köhler-Rollefson (1988, 1992; Rollefson and Köhler-Rollefson 1993) that pastoralism began this early.

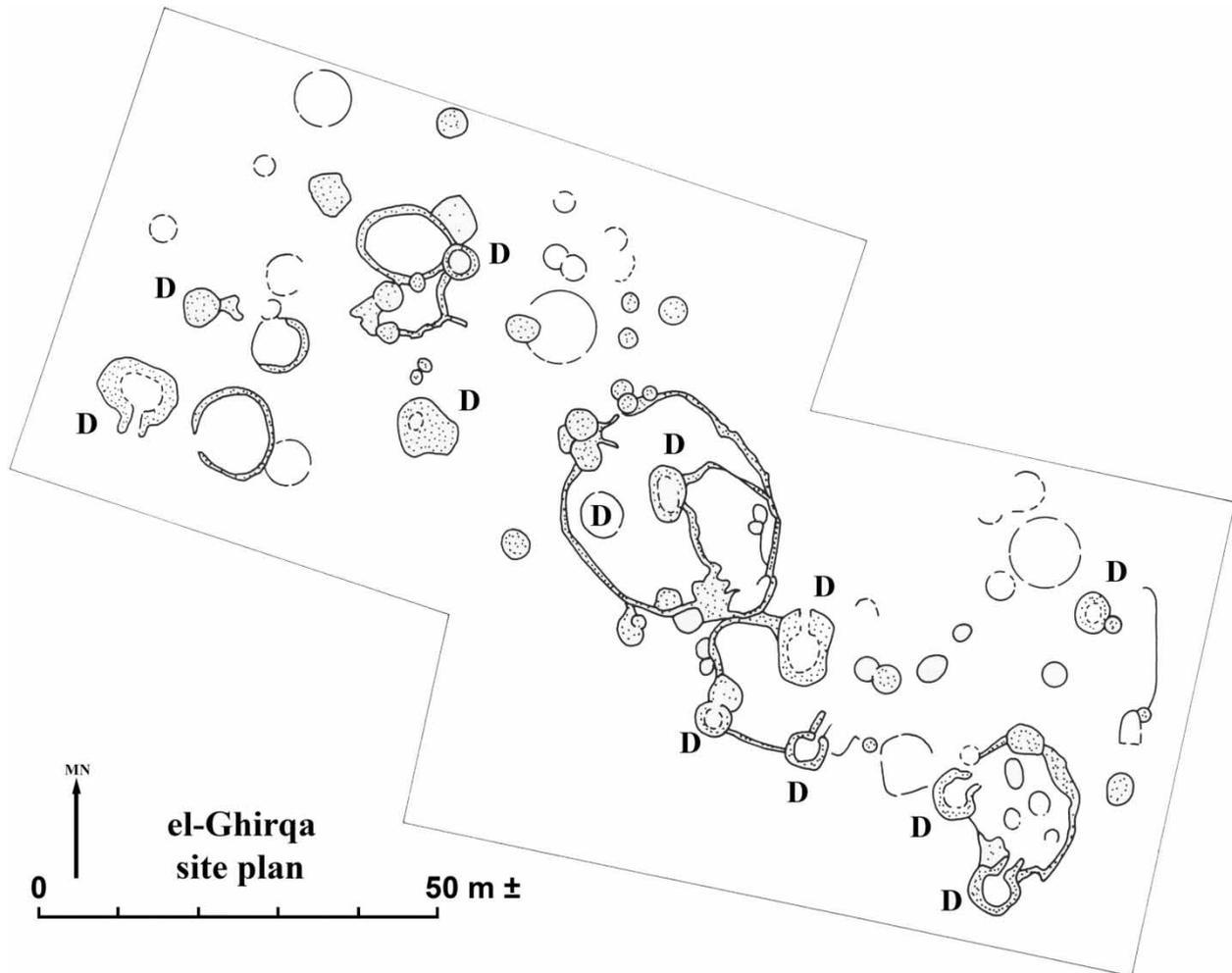


FIGURE 5 Plan of the Late Neolithic settlement at al-Ghirqa (after Betts 1987: fig. 3).

Research by Betts and her colleagues in the forbidding basalt-strewn Black Desert has considerably expanded our information concerning PPNB and LN exploitation of this hyper-arid area of eastern Jordan (Betts 1998, 2013). With one exception, LN sites along its western fringes appear to have been temporary camps or work sites, often burin sites that are characteristic of the Black Desert, although they are also found in arable areas farther to the west (e.g. Rollefson *et al.* 1982; MacDonald *et al.* 1983: 316), albeit infrequently. Often the burin sites were simple lithic scatters,<sup>2</sup> although several were associated with animal pens, and the site at Jebel Naja had crude architecture that may have housed up to two families (Fig. 4). LN Dhuweila (Fig. 1) appears to have used an earlier permanent LPPNB structure intermittently; indications are that the group was relatively small (Betts 1998: 48). The lone exception to the

<sup>2</sup>The burin sites at 'Jibal al-Qattafi' (Betts 2013: 35 and fig. 2.20) are located at the base of Mesa M-10 in the numbering scheme proposed by D. Kennedy and the APAAME project (Kennedy n.d.).

generalization that LN groups were essentially one or two families working as a socio-economic unit was the complex of dwellings and animal pens at al-Ghirqa (Fig. 5), where there were at least 12 circular dwellings in one cluster, with at least one more, smaller, cluster nearby (personal observation; cf. Betts 1987).

At the eastern edge of the Black Desert, survey and excavation in the Burqu' region and south to the Saudi border area (Fig. 1) yielded mostly LN lithic scatters (including burin sites), some associated with corrals. One site (Site 89/8) near Tell al-Hibr (*c.* 20 km east-south-east of Wisad Pools) consisted of a cluster of dwellings not unlike al-Ghirqa, with a lithic inventory dominated by burins, but with Haparsa, Amuq, and transverse arrowheads as well (Betts 2013: 165); there is little detail provided concerning the number, sizes, and types of structures.<sup>3</sup> Overall, LN sites in the

<sup>3</sup>It is interesting to note that there is a PPNB campsite located on a kite wall, 'identical to that found at the PPNB hunting camp of Dhuweila' (Betts 2013: 165–67). Besides, as was the case at Dhuweila, there is

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**FIGURE 6** Aerial view of the central core of Wisad Pools. Numbers refer to field assignments during the 2009 field survey. *Original photo by David Kennedy; ©APAAME, by permission*

region east of the basalt usually have only one dwelling structure (although it may be multi-roomed) with the exception of Site 89/8.

### Summary

Overall, the results of the research by Betts and Garrard paint a portrait that is vivid in its portrayal: a territory that during the LN is peopled very sparsely by groups, usually numbering only a couple of families, passing from place to place on a schedule determined by the fleeting availability of water and pasturage. The only exceptions to this vacant territory are the sites of al-Ghirqa and Site 89/8, where clustered housing perhaps reflects the rare macro-banding of families in exceptional circumstances, for undetermined lengths of time. The impression gained from the painstaking efforts of these researchers is that nomadic pastoralism was an adaptation that began almost imperceptibly in terms of impact, and that the new lifestyle grew gradually over a long time. We would suggest that another scenario more realistically describes the development of the emerging herder-hunter exploitation of the Eastern Badia during

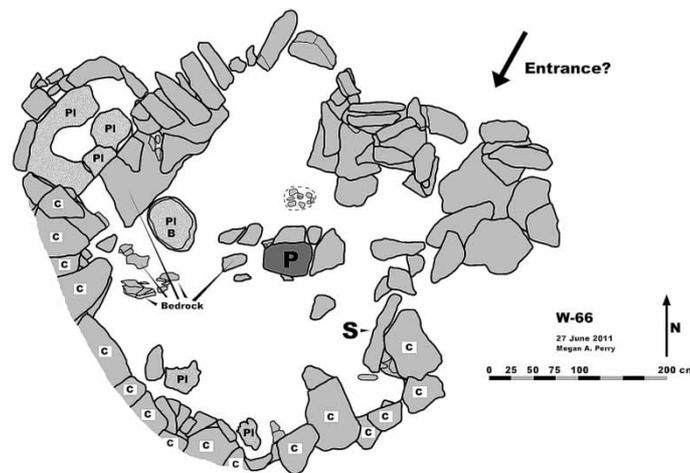
the LN, one that involves considerable dynamism and interaction.

### Wisad Pools

Wisad Pools is a geomorphological complex that entails a wadi that descends, only about 8 m, from one plateau to another over a length of *c.* 1–1.5 km. Within this descent, there are a number of natural depressions in the basalt basement of the drainage that trap water during the rainy season. Thus far, we have tentatively identified at least 9 pools, although some of these may be artificial barrage structures of an unknown date. Measurements of Pool No. 1 (some 130 m in length), relying on silt lines on basalt blocks lining the pool, showed that it could contain more than 2000 m<sup>3</sup> (more than a half-million US gallons) of water; Pool No. 1 was larger by far than Pools Nos 2–8, but Pool No. 9 was immense: ranging over more than a half kilometre, with a width between 20 and 30 m, but with a shallow depth (30–40 cm?), it appears to have been sufficiently large to have supported a small LN village at its debouchment onto an adjacent *qa* (playa).

The site is enormous, with structures of indeterminate ages stretching across an area of 3 × 3.5 km,

rock art involving ostriches, while at Dhuweila the art concerned large herbivores.



**FIGURE 7** Top plan of W-66, a Late Neolithic house at Wisad Pools.  
Drawing by M. Perry and G. Rollefson

although the ‘core’ area, where the architectural elements are most densely concentrated, covers about 1.5 km<sup>2</sup> (Fig. 6) (Rollefson *et al.* 2011b: fig. 12). Research has been underway at the site since 2008, with surveys in 2008 and 2009 and excavations in 2011 and 2013 (Rollefson *et al.* 2011a, 2013). It is not yet certain how many structures are located in the core area, but the number is probably greater than 300, not counting walls of animal pens (Rollefson *et al.* in press). Tower tombs of two sorts, and high mounds, are taken to be burial structures, and after the survey seasons it was thought most of the lower mounds were also tombs; that assessment was only partially correct.

The first mound (W-66) excavated in 2011, turned out to have nothing to do with interments, but was instead a collapsed corbelled house (Fig. 7) that had continued in use as a ‘working area’ long after the original dwelling was initially abandoned and the ceiling had collapsed. The original building had a gypsum-plaster floor, as well as a gypsum-plaster-lined floor basin, and charcoal<sup>4</sup> in the plaster yielded a radiocarbon date of 7690 ± 40 bp 6606–6455 cal BC (±2σ, Beta-346621). Within the post-abandonment fill of the working area was a red-painted herringbone incised potsherd of Yarmoukian form, as well as more than 40 arrowheads, mostly transverse and Haparsa types (Rollefson *et al.* 2011a). Other artefacts included a considerable number of grinding slabs and hand stones that await further analysis; among them was a cache of 11 pestles graded in size from *c.* 10–25 cm

in length. Two more collapsed houses of similar corbelled construction were observed nearby.

The goal of the 2013 season was to excavate one of the ‘tailed tower tombs’ (W-85), but unfortunately it had been looted in the interval since the 2011 season. Attention was turned to another tomb (W-80) that appeared to be situated on top of a basalt platform. The burial turned out to be badly disturbed (possibly by burrowing animals), and the bone was also not well preserved. After exposing half of the tomb to the base of the walls, digging continued to obtain an appreciation of the character of the underlying platform. The platform turned out to be another collapsed corbelled dwelling, of about the same size as W-66. Although the original floor was not reached in the 2013 season, there was evidence of episodic gypsum plastering of surfaces in the fill of the collapsed house. As was the case for W-66, the abandoned dwelling was used as a windbreak inside which butchering, stone tool manufacture (396 cores were recovered), and bead production took place; grinding slabs were abundant, as well as several large pestles. A focus on hunting is reflected by a total of 303 arrowheads (88% of them transverse types) recovered from the fill (Table 1; Fig. 8) (Rollefson *et al.* 2013). Two decorated Yarmoukian potsherds (and several other non-diagnostic sherds) were excavated from the interior of the house. Three radiocarbon dates on charcoal arranged from lower to higher stratigraphic units are as follows: 7620 ± 40 bp, 6590–6580 cal BC (±2σ, Locus 022, Beta 366677); 7010 ± 40 bp, 6000–5840 cal BC (±2σ, Locus 033, Beta 366676); and 6730 ± 40 bp, 5710–5610 cal BC (±2σ, Locus 011, Beta 366675).

Architecturally, W-80 shared some elements with W-66, although there were also some differences.

<sup>4</sup>Fuel in the Badia was brush (e.g. *Anabasis* sp., B. Lorenzen, pers. com.), so the ‘old wood’ problem is not applicable at Wisad Pools nor at the Wadi al-Qattafi sites.

**TABLE 1** Tool types from the sediments excavated from structure W-80 in the 2013 season at Wisad Pools

Tool type	<i>n</i>	%	%'	Arrow type	<i>n</i>	%	%'
Burins	12		3.0	Transverse, stemmed	96		33.9
Truncations	37		9.1	Transverse, triangular	87		30.7
Endscrapers	10		2.5	Transverse, trapezoidal	55		19.4
Scrapers	55		13.6	Transverse, indeterminate	11		3.9
Tabular scrapers	21		5.2	Haparsa	14		4.9
Seam knives	8		2.0	Nizzanim	11		3.9
Unifacial knives	19		4.7	Herzliya	8		2.8
Bifacial knives	4		1.0	Byblos	1		0.4
Bifaces	2		0.5	<i>Subtotal</i>	283		99.9
Backed elements	3		0.7	Indeterminate	20	6.6	
Tanged blade	1		0.2	<i>Total</i>	303		
Perforator	4		1.0				
Borer	46		11.4	Arrowheads	303	36.1	42.8
Drill	42		10.4	Non-arrowheads	536	64.9	57.2
Mèche de foret	3		0.7	<i>Total</i>	839		
Wedges	11		2.7				
Denticulates	52		12.8				
Notches	61		15.1				
Retouched bladelets	6		1.5				
Other	8		2.0				
<i>Subtotal</i>	405		100.1				
Retouched pieces	62	11.6					
Utilized pieces	18	3.4					
Hammerstones	2	0.4					
Unclassifiable	49	9.1					
<i>Total</i>	536						



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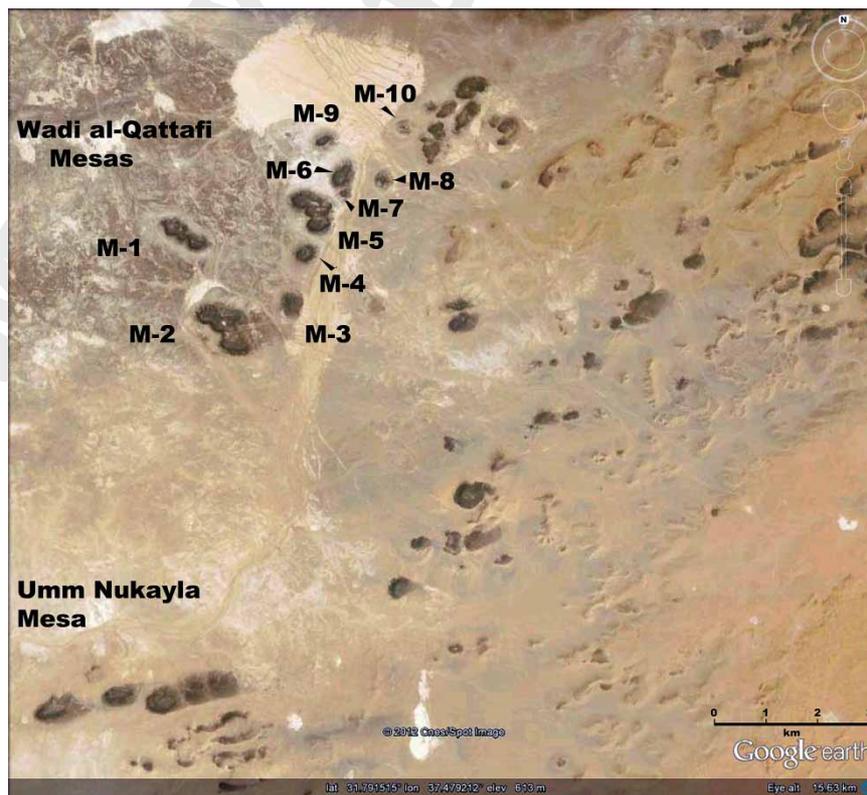
**FIGURE 8** Types of transverse arrowheads from the excavation of W-80 at Wisad Pools. Top row: stemmed type, middle row: triangular type, bottom row: trapezoidal type. Photo by G. Rollefson

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**FIGURE 9** Aerial view of the excavation of W-80, an elaborate Late Neolithic dwelling at Wisad Pools. WF is the western forecourt; P is the porch; D is the doorway; V is the unexcavated vestibule; A is the alcove; and B indicates the bench/platform of the main room; North arrow is approximately 1 m long. Photo: Y. Rowan

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**FIGURE 10** Google Earth image of the Wadi al-Qattafi and Umm Nukhayla mesas.

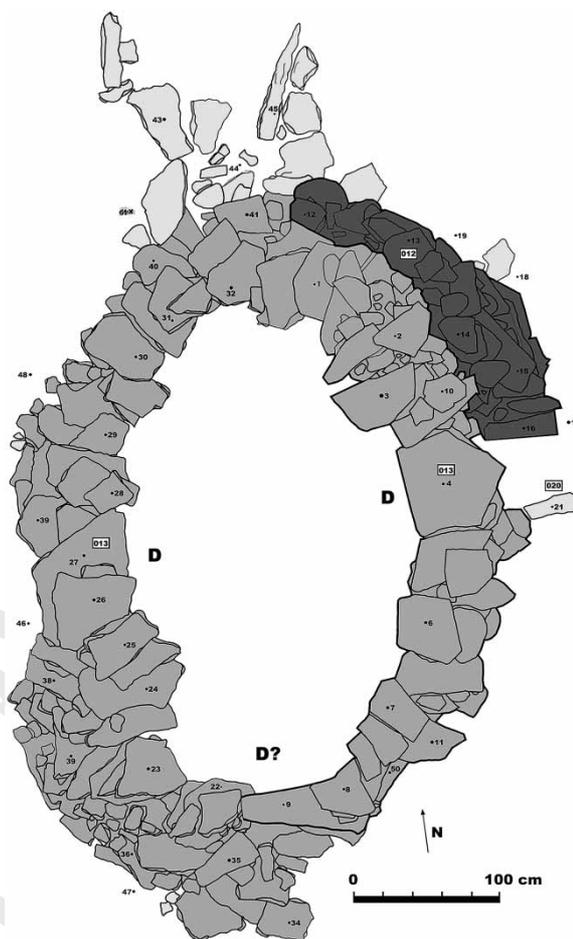
The house W-66 had a basalt platform adjacent to its eastern wall, while W-80 had no such platform; instead, a forecourt was ‘fenced’ with upright slabs to the west of the structure (Fig. 9). In the interior of the house there was an alcove (as there was at W-66), though in W-80 there were several successive basalt slab pavements (sometimes plastered). In the main room of W-80 was a bench or narrow platform made of small, flat basalt boulders along the southern wall; this was constructed after the abandonment of the original structure. Between the western forecourt and the house was an oval ‘porch’ measuring 2.2 × 2.7 m; this might have been an exterior workspace during the habitation of the original structure, but this requires confirmation by another season of excavation.<sup>5</sup> Finally, there was a doorway in the western wall of the house that led into a vestibule, which was not excavated in 2013.

### Mesa-4 (‘Maitland’s Mesa’)

Research at the basalt-topped mesas in the Wadi al-Qattafi (Fig. 10) began with two seasons of survey in 2008 and 2010, followed by an excavation season in 2012. Work has focused on Mesa-4, popularly known as ‘Maitland’s Mesa’. More than 250 structures (including huts, animal pens, and a tower tomb with a ‘tail’ of 53 constructed chambers along the southern edge) have been mapped on the summit, and nearly as many more have been located on the slopes and base of the mesa (Rowan *et al.* 2011; Wasse *et al.* 2012).

Structure SS-11 was selected for excavation in view of the well-constructed doorway on its west side, which superficially resembled *nawamis* in the Sinai and Yemen (e.g. Bar-Yosef *et al.* 1983; Braemer *et al.* 2001). It soon became clear that this was not a *namus* but an oval, corbelled dwelling c. 2 × 3 m with one door opening towards the southwest and another opening towards the east onto a courtyard/animal enclosure c. 15 m in diameter (Fig. 11). The walls of the house consisted of corbelled stacks of basalt slabs on three sides of the structure, but the south-south-east wall also included massive slabs set on edge. In the corner between the south-east part of the house wall and the southern wall of the adjacent courtyard/corral, the inhabitants had constructed a small corbelled storage room 1.88 × 1.45 × 0.45 m

<sup>5</sup>It is also possible that the ‘porch’ was a circular tent with low upright slabs around its perimeter. In the centre of the ‘porch’ is a large basalt slab with a small pecked circular depression (c. 20 cm dia. and 5 cm deep) that may have served as the base of a central tent pole. In view of the large quantities of animal bones in the W-80 fill, the tent may have been the preferred sleeping quarters of the people working in W-80. Another possibility is that it was a porch that was later converted to a tent.



**FIGURE 11** Top plan of house SS-11 at the south-western slope of Mesa-4; D indicates doorways of the house.

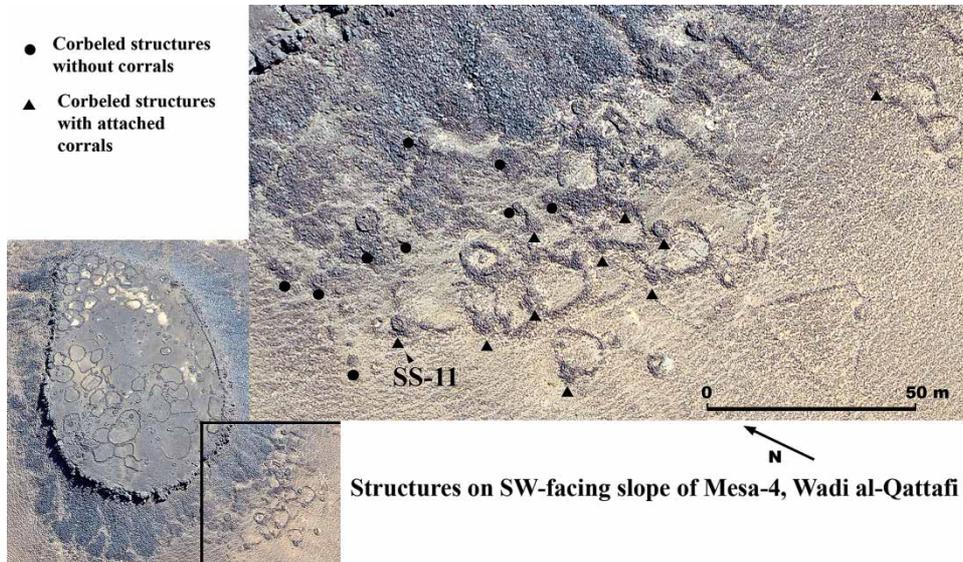
*Drawing by A. Wasse and G. Rollefson*

(Wasse *et al.* 2012: 21 and figs 9–10). A charcoal sample from a small hearth inside the house produced a radiocarbon date of 6450 ± 40 bp, 5475–5325 cal bc (2σ, Beta-346614).<sup>6</sup> Only two Late Neolithic arrowheads were recovered, and there was little evidence of grinding equipment; animal bones were also very sparse in the excavation.

Other small-corbelled structures were noticed nearby on the south-west slope of Mesa-4, 9 that perhaps constitute a ‘village’ not associated with animal enclosures and another of 10 houses, like SS-11, joined to corrals (Fig. 12). This might suggest that this area was occupied during two different phases, with the isolated houses potentially dating to an earlier phase of the Late Neolithic.

<sup>6</sup>All 14C dates were calibrated using the Intcal 09 program. This date complements Betts’ observation that there was ‘a shift from clustered room architecture to corral with attached room which occurs in both the Sinai/Negev region and the Badia around the Late Neolithic to Chalcolithic periods’ (Betts 2013: 189).

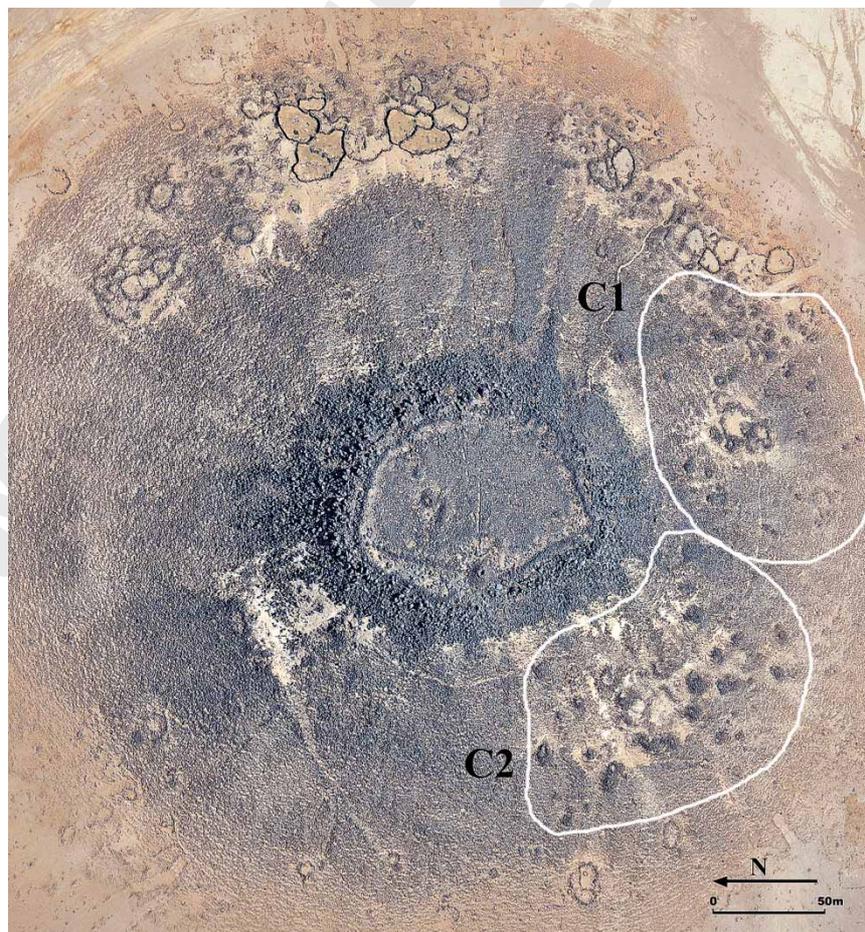
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**FIGURE 12** The 'village' of structures on the south-western slope of M-4. Black circles are corbelled structures without corrals; black triangles are corbelled houses with attached corrals. Original photos by D. Kennedy; ©APAAME, by permission

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**FIGURE 13** Aerial view of mesa M-8 and at least two clusters (C1 and C2) of structures on the south-east and south-west slopes; there are also two Late Prehistoric tower tombs, one of which was used as the base of a Safaitic tomb. Original photo by D. Kennedy; ©APAAME, by permission

### Other Wadi al-Qattafi mesas

There are around 30 mesas along the Wadi al-Qattafi and 22 more in the Umm Nukhayla chain located 8–10 km to the south of M-4. Brief visits were conducted to seven mesas in the Qattafi group, besides M-4, and five along the Wadi Umm Nukhayla. All of them bore one or two tower tombs, often with tails of low cairns, and all mesa summits also had small hut structures and animal enclosures, but none of them approached the number on top of M-4. The Umm Nukhayla mesas had very few examples of buildings and animal enclosures on the slopes or at the bases, which stands in stark contrast with the hills on both sides of the Wadi al-Qattafi. Mention has already been made of the 19 (or more) houses at M-4, but even more astounding are the concentrations of structures at other mesas. We do not suggest, of course, that the structures at any of these concentrations of buildings were occupied simultaneously, although the sheer number at some locations might argue some of them were coeval, although we cannot determine how many this might be.

Mesa-8 is small (100 × 75 m across the summit) located on the eastern bank of the Wadi al-Qattafi about 2 km northeast of M-4. While there are structures on all slopes and the base of the mesa, there are two clusters of what are probably dwellings, one group of 20 buildings on the eastern slope and the other comprising 24 structures on the south-west

slope (Fig. 13). Across the wadi are Mesas 5, 6, and 7, 1.5 km, 850 m, and 750 m from M-8, respectively (Fig. 14). M-5 has many relatively recent animal enclosures along the western and southern slopes, but at the north-eastern edge of the mesa there are two clusters that might be Late Neolithic in age, based on their similarity to the architecture at M-4 and Wisad Pools. The western cluster (C2) has 24 buildings, while the larger eastern cluster (C1) has 64 in addition to some large mounds (Fig. 15).

However, it is around M-7 that one is struck by the absolute number and density of corbelled structures (Fig. 16). There are possible concentrations, but they are difficult to distinguish confidently either on the ground or in aerial photographs. Altogether there are at least 287 buildings, not counting obvious animal pens. Two different construction techniques might allow us to segregate, to a broad degree, different periods of occupation. One of them is the use of stacked corbel stones, similar to those used in the houses without attached corrals at M-4 and Wisad Pools (Fig. 17A), and the other technique is the placement of basalt blocks on edge (Fig. 17B), a variability that Betts (2008: 34) has noted for the larger sites at the al-Ghirqa *qa*. This requires confirmation through fieldwork, but there is the impression that the vertical slab buildings tend to be located lower down the slopes of M-7.

There are also a considerable number of structures at the western tip of Mesa-1, possibly associated with

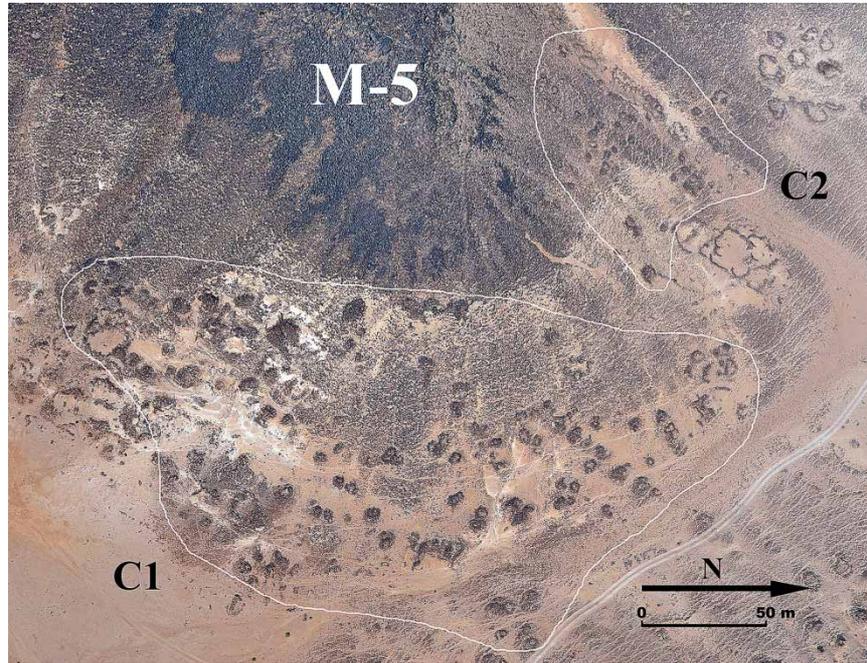


**FIGURE 14** Aerial photo towards the west of a tributary wadi that debouches into the Wadi al-Qattafi and the relative position of mesas M-5, M-6 and M-7.

*Original photo by D. Kennedy; ©APAAME, by permission*

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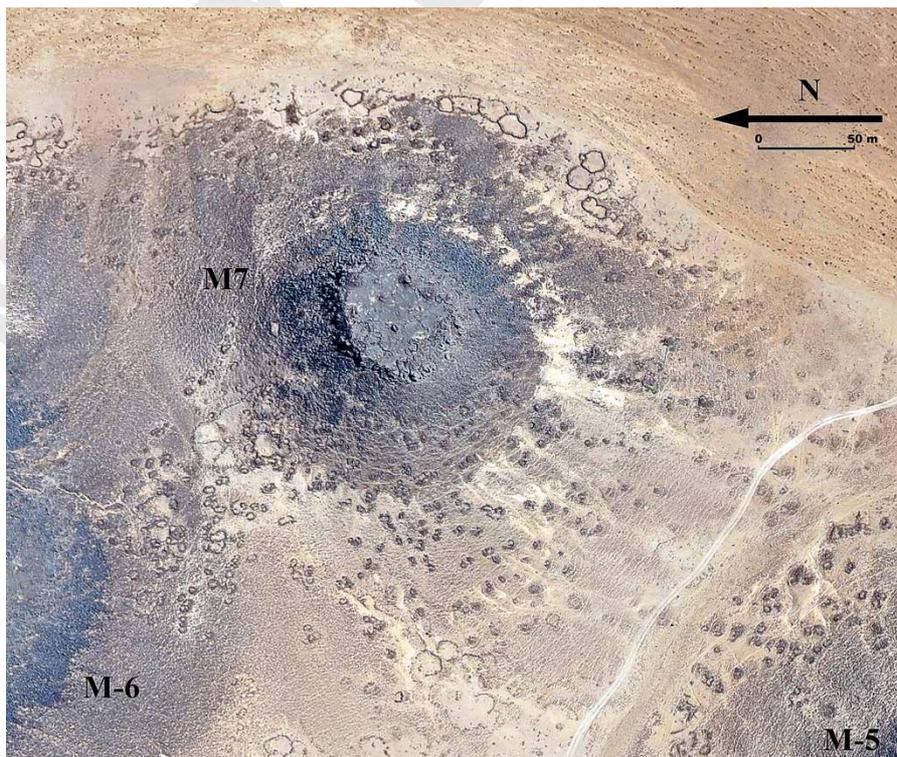


**FIGURE 15** Structures on the northeast slope of mesa M-5. There are at least two distinct clusters: C1 and C2. *Original photo by D. Kennedy; ©APAAME, by permission*

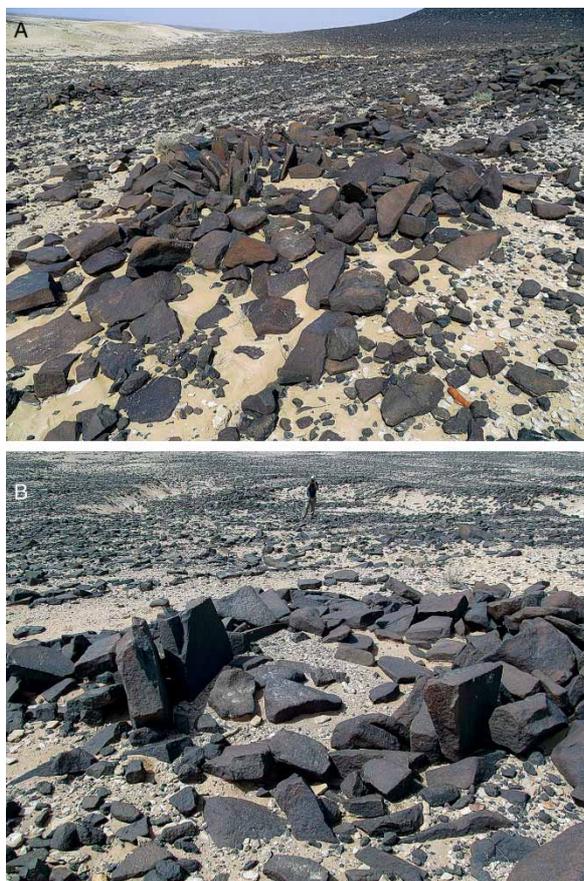
'wheels' (Kennedy 2011: 3189) or 'jellyfish'. Betts (1982: 186) has tentatively suggested a Late Neolithic age for 'Jellyfish' QMJ 14J based on a possible association with a burin site, but these have not yet been

visited. The same situation pertains to M-10, where Betts (2013: 32–40 and fig. 2.20) located three Late Neolithic burin sites; structures appear to be particularly numerous at the eastern base of the mesa. For

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**FIGURE 16** View towards the east of structures encircling Mesa M-7. There are also Safaitic tombs on the summit of the mesa. *Photo by D. Kennedy; ©APAAME, by permission*



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**FIGURE 17** Construction styles of buildings at the foot of M-7. (A): corbelled houses; (B): upright slab construction. Photos: G. Rollefson

the remaining mesas, there are only a few scattered structures, even those less than a kilometre or two to the east and northeast of M-10, despite their proximity to the edge of the large *qa* known as Landing Ground E by the Royal Air Mail (Hill 1929: Map III).

### Desert adaptations in the Negev and Sinai

Surveys in the Negev and Sinai deserts have recorded numerous Neolithic sites, although PPNB settlements outnumber those of the LN (Avner 2006: tables 1–4). All of the PPNB sites appear to be of hunter-gatherer groups, although at Nahal Issaron the dominance of goats in the faunal remains has led to speculation that these animals were domesticated (Goring-Morris and Gopher 1983: 161). The LN sites share several similarities with their contemporaries in the Badia of eastern Jordan, especially in terms of lithic typology and technology and, to some degree, architecture. In general, the LN sites do not appear to have been large.

Kvish Harif is a small settlement in the central Negev. The site is small and consists of what appears to be a circular enclosure, with one (possibly two)

circular room attached to the low stone wall (Rosen 1984: 112 and fig. 2). The site configuration might suggest a small mobile group of people, and although faunal remains were poorly preserved, the stone enclosure is an indication that the residents may have managed a small herd of caprines.<sup>7</sup>

The lithic assemblage from Kvish Harif is closely related to the material from Wisad Pools. Arrowheads make up 14 per cent of the chipped-stone tools, and of these, 88 per cent are transverse examples similar in diversity to the Wisad types (compare with Table 1 and Fig. 8; Rosen 1984: 114–15 and Figs 6–7). Tabular scrapers are also numerous, and as is the case at Wisad, truncations are frequent in the collection (Rosen 1984: 116 and fig. 4). A single radiocarbon date yielded a calibrated date of *c.* 4100 cal BC (Rosen 1988: 501), but the lithic technology and typology lead Goring-Morris to suggest that the site was considerably older (Goring-Morris 1993: 82).

Another Negev site with strong lithic resemblances is Nahal Issaron in the southern Negev desert. Excavations uncovered more than half of the area of the site, which measured *c.* 400 m<sup>2</sup> or less (Goring-Morris and Gopher 1983: 153, 161). The settlement includes strata from the PPNB, Late Neolithic, and Chalcolithic periods, with calibrated radiocarbon dates that range from the 5th to 9th millennia (Carmi *et al.* 1994: 396 and fig. 3). Only the PPNB architecture is well preserved, probably due to severe erosion during flooding episodes in the 7th millennium or later that severely damaged layers overlying the PPNB settlement (cf. Carmi *et al.* 1994: 396). Nevertheless, the lithics that can be ascribed to the Neolithic include Haparsa, Nizzanim, Herzliya, and tanged and triangular transverse arrowheads (Goring-Morris and Gopher 1983: fig. 4; Goring-Morris 1993: 81 and fig. 11). Bone preservation was poor in the layer with LN artefacts, and architectural remains were also scarce.

### Discussion

The accounts of Garrard and Betts, as they relate to the beginnings of pastoralism in the arid regions of Jordan, leave one with the impression that this new economic system began haltingly, for with the exception of al-Ghirqa, the sites discussed are small and include housing for only one or two families. Rosen concluded that by the later Neolithic there were

<sup>7</sup>Rosen notes that the few identifiable bones are 'attributable to *Capra*, *Capra/Ovis*, and, in one case, possibly to *Gazella*', noting that determination of the wild/domestic state of the animals was not possible (1984, 119; 1988, 501).

seasonal episodes of macro-banding (Rosen 2008: 120), ‘something for which there is no apparent evidence in the Badia’ (Betts 2013: 189). However, ongoing research at Wisad Pools and the Wadi al-Qattafi mesas has provided that evidence, and there is every reason now to characterize the beginning of nomadic pastoralism as an energetic process beginning as early as the PPNC/ELN as demonstrated at Jilat 13 and Jilat 25 (Garrard *et al.* 1994b; Betts 2008; Martin and Edwards 2013: 69, 73), if not earlier.

The concentrations of structures at Wisad Pools and some of the Wadi al-Qattafi mesas add considerable detail to the Late Neolithic situation in the Badia. There are many more such concentrations, especially near the eastern edge of the Black Desert, but these have not been visited by anyone to our knowledge.<sup>8</sup> Although it is not yet possible to demonstrate that occupation was contemporaneous at any two or more of the structures, the sheer numbers of buildings, and their density close to seasonal water sources, suggests a much larger population in the Badia, than, perhaps, previously imagined.

There have been two major competing hypotheses to account for the emergence of pastoral nomadism. Byrd (1992) proposed that the indigenous hunter-gatherers of the Badia adopted domesticated resources (plants and animals both) from the west to diversify their assets and chances for survival. Betts (2013) supports this hypothesis, and Martin (1999) agrees, arguing that the kill-off patterns among caprines in the Badia sites do not fit a model wherein the sheep/goats were being fattened on seasonal vegetation for exchange with sedentary populations in the arable regions. The second hypothesis is by Köhler-Rollefson (1988, 1992), who postulates a movement into the Badia by segments of the farming population during the PPNC during the growing season (coeval with the rainy months) until the completion of the harvest, relieving the pressure that sheep and goats would have placed on fields near permanent settlements. This model also brings up a change from relying on caprines, simply as sources of meat to increasing reliance on dairy production, greatly increasing the efficiency of converting steppe/desert vegetation to nutrition useful to the herders and farmers alike. This suggestion has recently received strong support from Vigne and Helmer (2007).

Some of the argumentation over the competing hypotheses is probably futile, and there is little reason to declare that the development of pastoral nomadism was either one or the other. Instead, both scenarios were probably in play for several reasons. First, the Köhler-Rollefson model would have herders evolving from a mixed economy to an increasingly segregated economic strategy that involved exchange with farming communities in the west; the PPNC evidence at ‘Ain Ghazal, with long-term, semi-subterranean storage bunkers for part of the community, fits well with the hypothesis. The presence of sheep/goat populations at PPNC sites in the Wadi Jilat also adds credence, as does the eventual disappearance of permanent houses at ‘Ain Ghazal during the latest part of the Yarmoukian and the appearance of Yarmoukian tent structures later. The presence of typical Yarmoukian pottery at Wisad Pools, albeit rare, also argues for this kind of exchange.

Second, indigenous Badia groups had to obtain their domesticates from people already well versed in them and the strategies to execute the rewards; it must have been a constant temptation for arid-lands hunter-gatherers to assimilate to the delayed gratification entailed in the breeding process, and perhaps some of the kill-off patterns observed by Martin reflect this learning curve. To the contrary, faunal remains at W-66 and W-80 at Wisad Pools, currently under analysis,<sup>9</sup> indicate a very high percentage of gazelle and relatively rare presence of caprines, a strategy that would maximize the sustainability of the herds while enjoying the benefits of the ‘free food’ provided by gazelle and other steppe/desert fauna.

Third, there seems to have been a relatively large and sudden increase in the presence of human groups in the Badia, especially during the LN. While nomadic pastoralism may have contributed to an increase in population growth of the former hunter-gatherer groups, it is more likely that the LN groups were heavily represented by immigrants from areas that could no longer support large populations, especially when sheep and goats threatened already diminished resources in the arable lands.

Finally, and perhaps the least supportable at the moment, the variation in construction techniques might also reflect two populations, each with its own traditional methods of constructing shelters. Counterarguments against this suggestion of

<sup>8</sup>For example, the Ghoussein cairn field at N 32.325954 E 37.997240 and the Bakhita cairn field at N 32.167766 E 37.918238. The APAAME photo sets (Kennedy n.d.) contain thousands of aerial images, and patient browsing reveals stunning numbers of structure concentrations, although the age of such clusters cannot be determined without pedestrian examination.

<sup>9</sup>Based on more than 280 NISP bones from three loci in abandoned house W-80, gazelle dominate by around 50 per cent, with hare around 25 per cent, and sheep and goats totalling about 10 per cent of the mammals. Large and small felids occur rarely, as does domestic dog. Birds are very numerous but have not yet been identified to genus/species level.

contemporaneous dual traditions include the possibility of a diachronic development of architecture, the direction of which we do not yet know. Furthermore, it is also likely that once pastoral nomadism had taken hold as a reliable economic pursuit in the Badia, interactions between the two groups developed to the point that the two groups merged socially into a single population, with exchanges of mates as important as exchanges of material goods.

One aspect of the emergence of nomadic pastoralism demands further consideration. As several researchers have mentioned (e.g., Wasse *et al.* 2012; Betts 2013; Rowan *et al.* in press), the bleak landscapes that typify the Badia today, especially the Black Desert, may have developed long after the Neolithic period ended. The current research of the Eastern Badia Archaeological Project includes attempts to reconstruct the soil system during the Holocene, and we hope that sediments in the local playas might reveal evidence of former topsoil, which in the Early and Mid-Holocene would have absorbed rainfall during the rainy season, augmenting the quality and expanse of vegetation for caprine herders and, therefore, increasing the length of time the groups could stay at water sources such as Wisad Pools and the playas near the Wadi al-Qattafi. Examination of some of the palaeoclimatic data that are available (Migowski *et al.* 2001; Bar-Matthews and Ayalon 2004, 2011) show fluctuations throughout the Holocene, but there is also an indication of a catastrophic decrease in rainfall in the western part of the Mediterranean coastal/Rift Valley region that would have been calamitous in terms of a rather sudden desertification of the Badia near the shift from the Early to Middle Bronze Ages at c. 2000 cal BC. Notably, very little evidence of post-EBA activity has been proffered until the Safaitic period, although some of the rock art in the Badia could be as early as the Iron Age introduction of horses and camels.

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