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Discovery and excavation of desert kites in the south-eastern Badia of Jordan

Wael Abu-Azizeh, Mohammad Tarawneh, Rémy Crassard and Juan Antonio Sánchez Priego

Although desert kites are widespread across Middle Eastern and Central Asian arid margins from Yemen in the south to Uzbekistan in the north (Meshel 1974, 2000; Ryckmans 1976; Adams et al. 1977; Parr et al. 1978; Perevolotsky and Baharav 1991; Yagodin 1998; Eddy and Wendorf 1999; Betts and Yagodin 2000; Van Berg et al. 2004; Brunner 2008; Holzer et al. 2010; Nadel et al. 2010, 2013; Skorupka 2010; Bar-Oz et al. 2011a; Kennedy 2011, 2012; Morandi Bonacossi and Iamoni 2012; Gasparyan et al. 2013; Kempe and Malabeh 2013; Zeder et al. 2013; Brochier et al. 2014; Iamoni 2014; Morandi Bonacossi 2014; Barge et al. 2015), their main concentration is in the *harra* basalt landscape of southern Syria and north-eastern Jordan (Helms and Betts 1987; Echallier and Braemer 1995; Betts et al. 1998; Kempe and Malabeh 2010a, 2010b, 2012; Kennedy et al. 2014). The availability of building materials in this region, specific climatic/weather conditions, and the presence of oases as well as periodically advantageous grazing lands are some factors that have been cited to explain the preference for this location (Helms and Betts 1987: 41–2).

The apparent total absence of these desert kites on the *hamada* limestone plateau of south-eastern Jordan remained puzzling for a long time, especially in view of their existence in the neighbouring arid regions of the Negev and Sinai. This absence became all the more perplexing as the intensification of archaeological research started to find evidence of important Late Prehistoric (Late Neolithic–Chalcolithic–Early Bronze Age) human occupation in this area

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The Gazelle's Dream

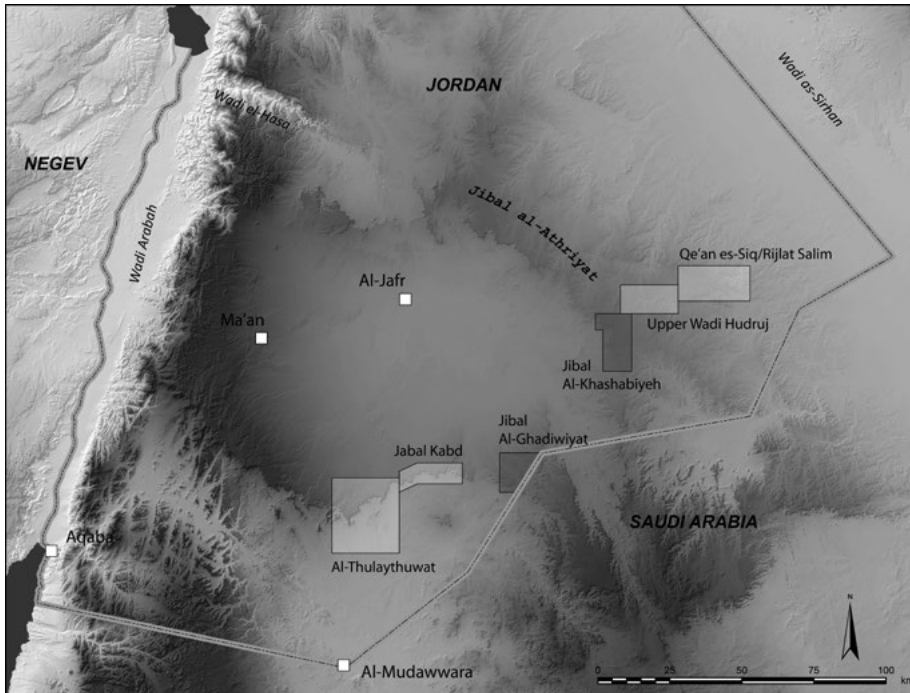


Figure 7.1 Map showing the location of the different study areas of the South Eastern Badia Archaeological Project in the desert margins of Jordan, including the areas of Jibal al-Khashabiyeh and Jibal al-Ghadiwiyat in which desert kites have been identified.

(Quintero et al. 2002; Wasse and Rollefson 2005; Tarawneh 2007; Abu-Azizeh 2010, 2013a, 2013b, 2014; Fujii 2013; Tarawneh and Abudanah 2013).

In the framework of the joint French–Jordanian South Eastern Badia Archaeological Project (SEBAP), we have recently been able to identify the first remains of kite structures in the south-eastern desert of Jordan, thus modifying our understanding of desert-kite distribution (Abu-Azizeh and Tarawneh 2015). The discovery of these structures was made possible by the analysis of open-access, high-resolution satellite imagery (available on Google Earth and Bing Maps). In total nine kites were identified in the remote desert landscape to the south-east of Al-Jafr: eight were grouped in a consistent and characteristic chain-like organisation in the study area of Jibal al-Khashabiyeh, while an isolated kite was found in the study area of Jibal al-Ghadiwiyat (Figure 7.1). The discovery of two distinct forms of kites in an area initially thought to be devoid of such structures was particularly striking. Not only did it fill a gap in the known distribution area of these structures, it also opened interesting perspectives for the study of the morphological and structural diversity of the attested kite types.

Following the initial remote-sensing study, three consecutive fieldwork seasons were conducted in both study areas during the summers of 2013, 2014, and 2015. The results of these preliminary investigations are presented in this chapter. The

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synthesis of the data underlines a clear local specificity in kite layout and use of topography. Moreover, the excavations provided solid evidence supporting a hunting function for these large-scale structures. They also provided the first direct evidence allowing the secure dating of the specialised hunting strategies involved in the kite phenomenon to the Pre-Pottery Neolithic B (PPNB).

Desert kites in Jibal al-Khashabiyeh

The study area of Jibal al-Khashabiyeh is located 70 kilometres to the east of Al-Jafr (Figure 7.1). It constitutes the eastern edge of the Al-Jafr Basin and is marked by an escarpment following a general north-south orientation (Figure 7.2). This escarpment is the western limit of a plateau that gently slopes towards the east and materialises in the study area in the form of the Jibal al-Khashabiyeh hills, which rise to a maximum altitude of 980 to 1000 metres above sea level. Geologically, the plateau is represented by a limestone bedrock including flint and chert beds. Its tabular surface is literally covered with fractured flint and chert debris, and this *hamada* landscape has been named ‘Ar dh as-Suwan’ (‘the land or territory of flint’) by local Beduins.

At least eight kites have been clearly identified in the Jibal al-Khashabiyeh area, forming a chain extending over 17 kilometres from north to south (Figures 7.2 and 7.3). The kites have the same general orientation, with their opening set towards the open landscape of the plateau to the east. Their drivelines converge at the escarpment break to the west. The length of the drivelines is variable but reaches a maximum of approximately 3.5 kilometres for JKSH 01 and JKSH 04. Their number also varies from three to four walls at JKSH 01, JKSH 04, JKSH 07 and JKSH 08 to over 10 walls or segments of walls. JKSH 05 is certainly the most complex kite identified and has a layout characteristic of the kite structures known in the north-eastern *harra*. The presence of a median driveline is also reminiscent of the *harra* kites and is attested several times (JKSH 02, JKSH 03, JKSH 04 and JKSH 05). The chain organisation of the kites is clearly evidenced by the fact that the drivelines of different structures leave very few gaps between them and sometimes almost interconnect. When significant gaps are left, as between JKSH 02 and JKSH 03 and between JKSH 06 and JKSH 07, the remains of eroded and unclear segments of walls have been identified in the field, suggesting that additional kites may have existed in these locations that have been destroyed by erosion.

Desert kites in Jibal al-Ghadiwiyat

The study area of Jibal al-Ghadiwiyat is located about 70 kilometres to the south-east of Al-Jafr (Figure 7.1). In the south of the area, aeolian sands form low dunes that accumulate in certain areas. The limestone plateau lies between 980 and 1020 metres above sea level in the northern sector of the study area. Another kite (JGHD 02) was identified here through the inspection of the high-resolution satellite images available on Google Earth and Bing Maps. Contrary to the chain described

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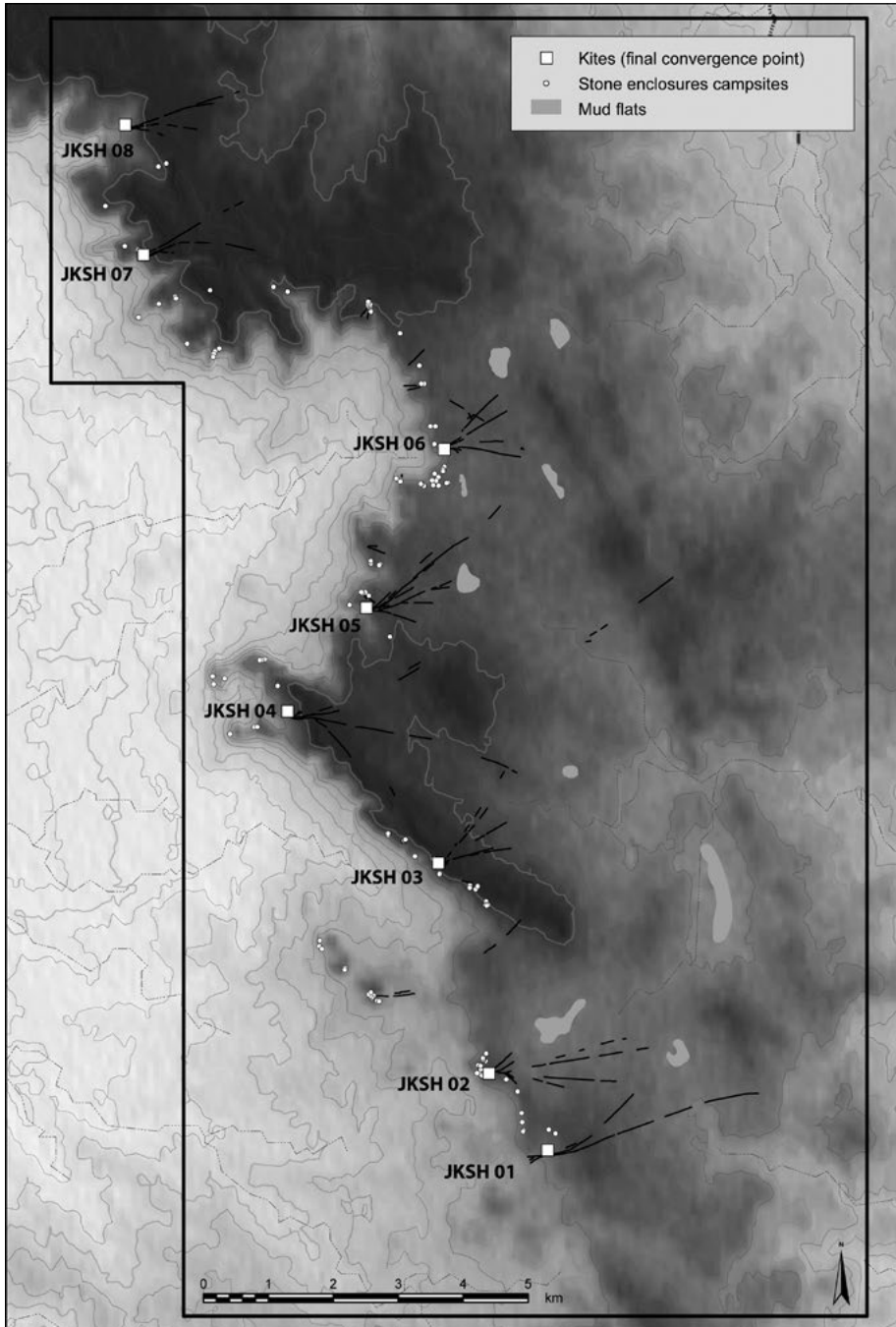


Figure 7.2. Map of Jibal al-Khashabiyeh study area, showing location of kites.

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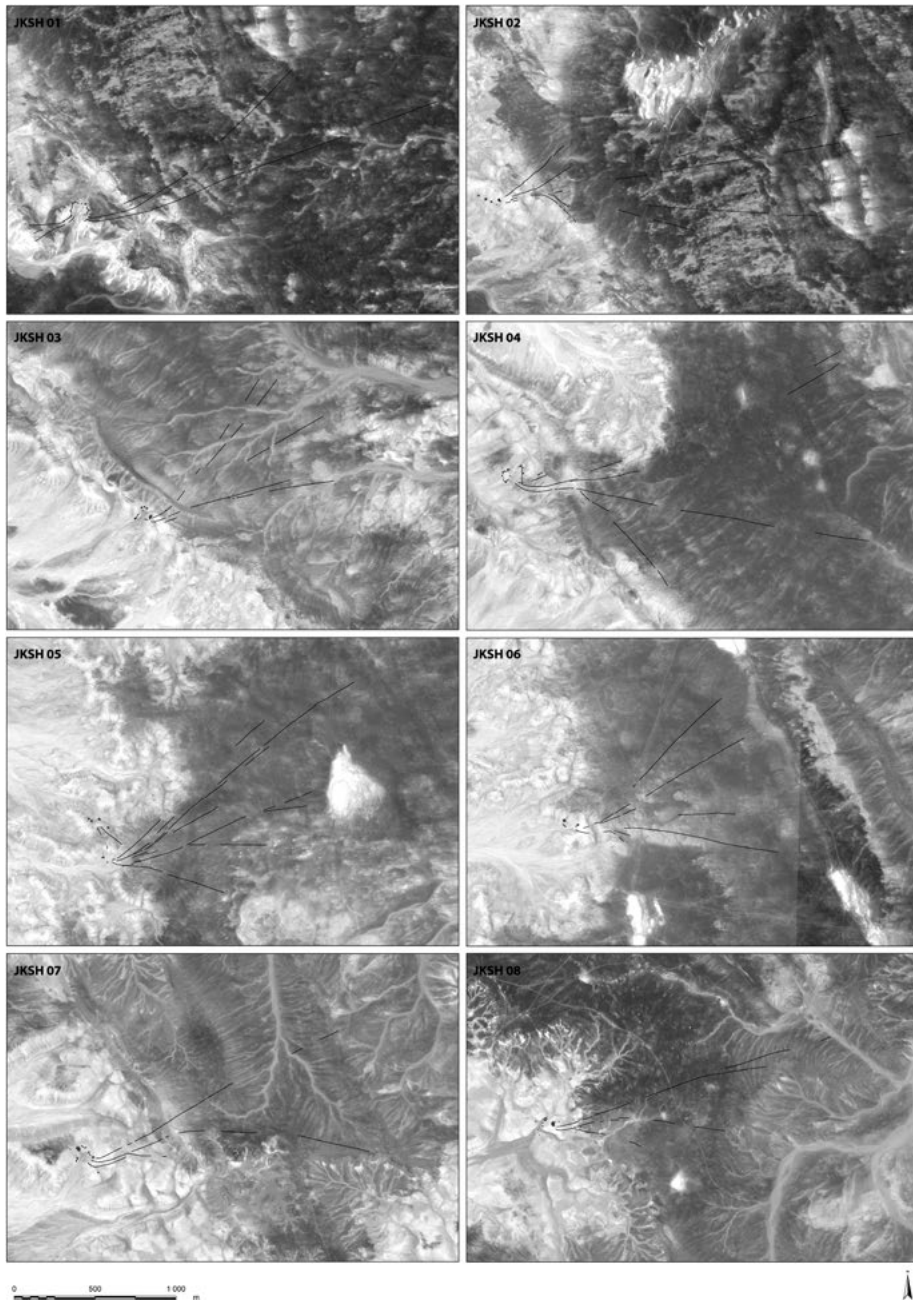


Figure 7.3. Satellite images showing the eight kites of Jibal al-Khashabiyeh area. (Google Earth™, Bing™ overlay; cartography by Wael Abu-Azizeh)

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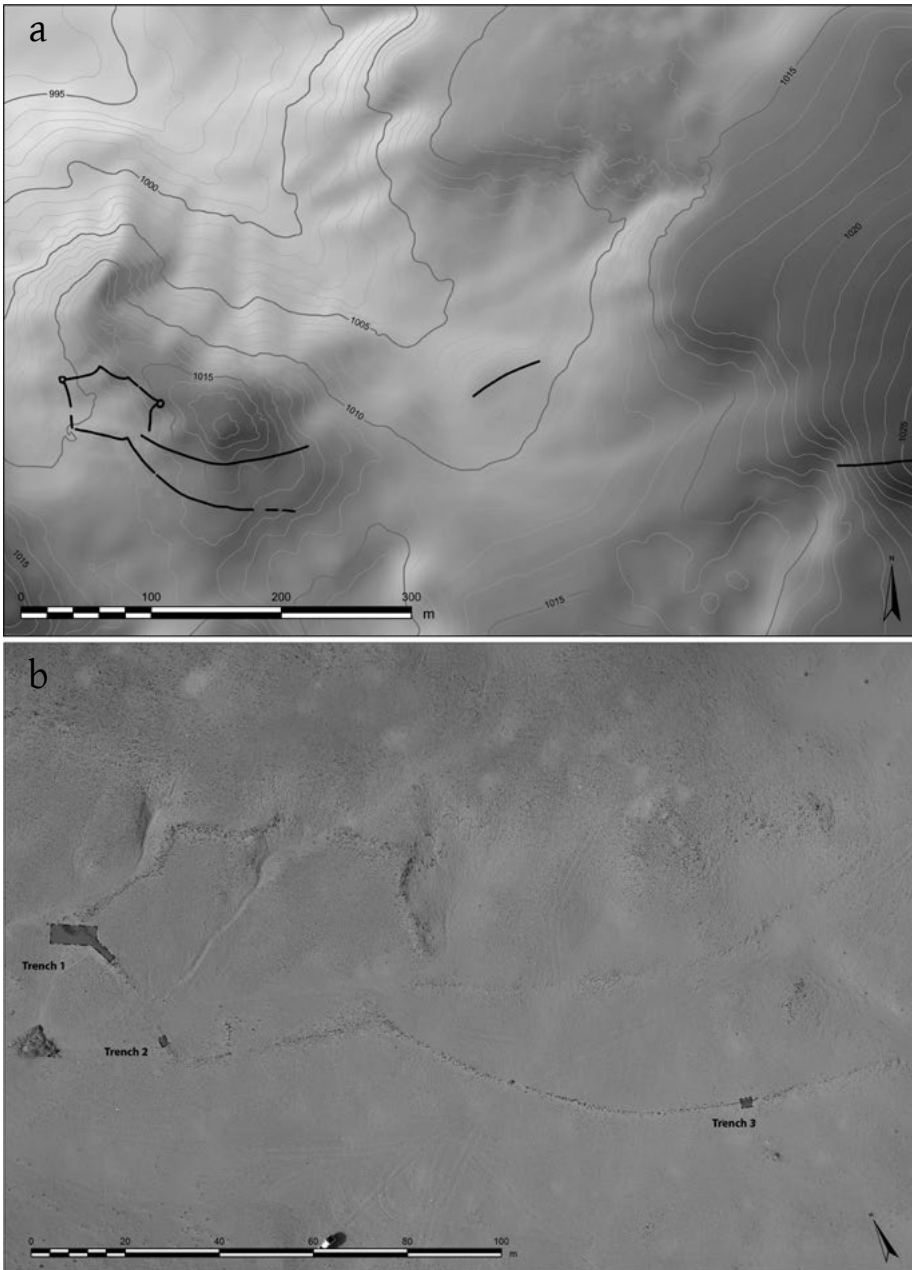


Figure 7.4. Digital elevation model showing the general topographical setting of kite JGHD 02 (top) and detailed orthophotomosaic with indication of excavated areas (bottom).

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above, this kite was apparently isolated. It therefore represents a different type of kite construction in the south-eastern Badia.

Kite JGHD 02 is located on the edge of the limestone plateau in an uneven landscape cut by the erosion of the Wadi al-Ghadiwiyeh Um Tor (Figure 7.4). The kite follows the typical generally east-west orientation. The funnel opens towards the east and narrows towards the west. Although the drivelines appear to be quite short on the satellite images (maximum of 150 metres long), field examination allowed the identification of additional wall sections, indicating that they were originally much longer, with the southern guiding wall being at least 650 metres long. The drivelines were set on the level surface of the *hamada* plateau to the east and have a layout similar to the drivelines of Jibal al-Khashabiyeh.

Architecture

Despite their distinct organisations (chain versus isolated) the various kites in the south-eastern Badia share a similar general morphology and topographical setting. The construction method of the kite walls is diverse but seems to have been determined by two factors. The first is related to the availability of raw material. The builders used rocks accessible in the immediate vicinity of the structure, and hence building techniques varied according to the structures' topographical and geographical setting. The preferred construction materials were limestone boulders or slabs. These are especially available along the escarpment edge, where heavy erosion has cleaved the limestone bedrock into smaller, manageable blocks. This enabled builders to gather a sufficient quantity of stones for the construction of walls, which have been preserved up to a height of 40 to 50 centimetres (Figure 7.5a). In some places rock formations of round limestone boulders, which are characteristic for this area, were used in a single row (Figure 7.5b). On the flattish *hamada* landscape of the plateau, limestone blocks are scarce and scattered. As a result, the drivelines of the kites here are formed by a haphazard assortment of stones, either of limestone or flint, and are no more than 20 to 30 centimetres high (Figure 7.5c-d). Interestingly, we observed that in these locations, the driveline often consisted of small concentrations of stones with gaps of several metres in between rather than a continuous stone line. Another noteworthy feature is that the drivelines contrast in colour with the black surface of the flint-strewn *hamada*.

The second factor affecting wall construction has to do with its distance from the enclosure. The wall segments most distant from the enclosure are usually composed of a random alignment of stones without any visible organisation. As one moves closer to the escarpment edge and enclosure, the drivelines become more clearly formed. Here they not only contain a greater quantity of stones but were also constructed more finely. In these locations, it was sometimes possible to identify a careful building technique, such as at kite JKSH 08, where a double-faced wall was recognised (Figure 7.6a). At kite JKSH 04, at the final approach to the enclosure, the drivelines and the enclosure itself were built using huge standing slabs, which were secured by an external row of smaller boulders (Figure 7.6b). In view of the different treatments granted to the construction of the walls, the final approach was obviously a crucial location in the use of desert kites for hunting (see below).

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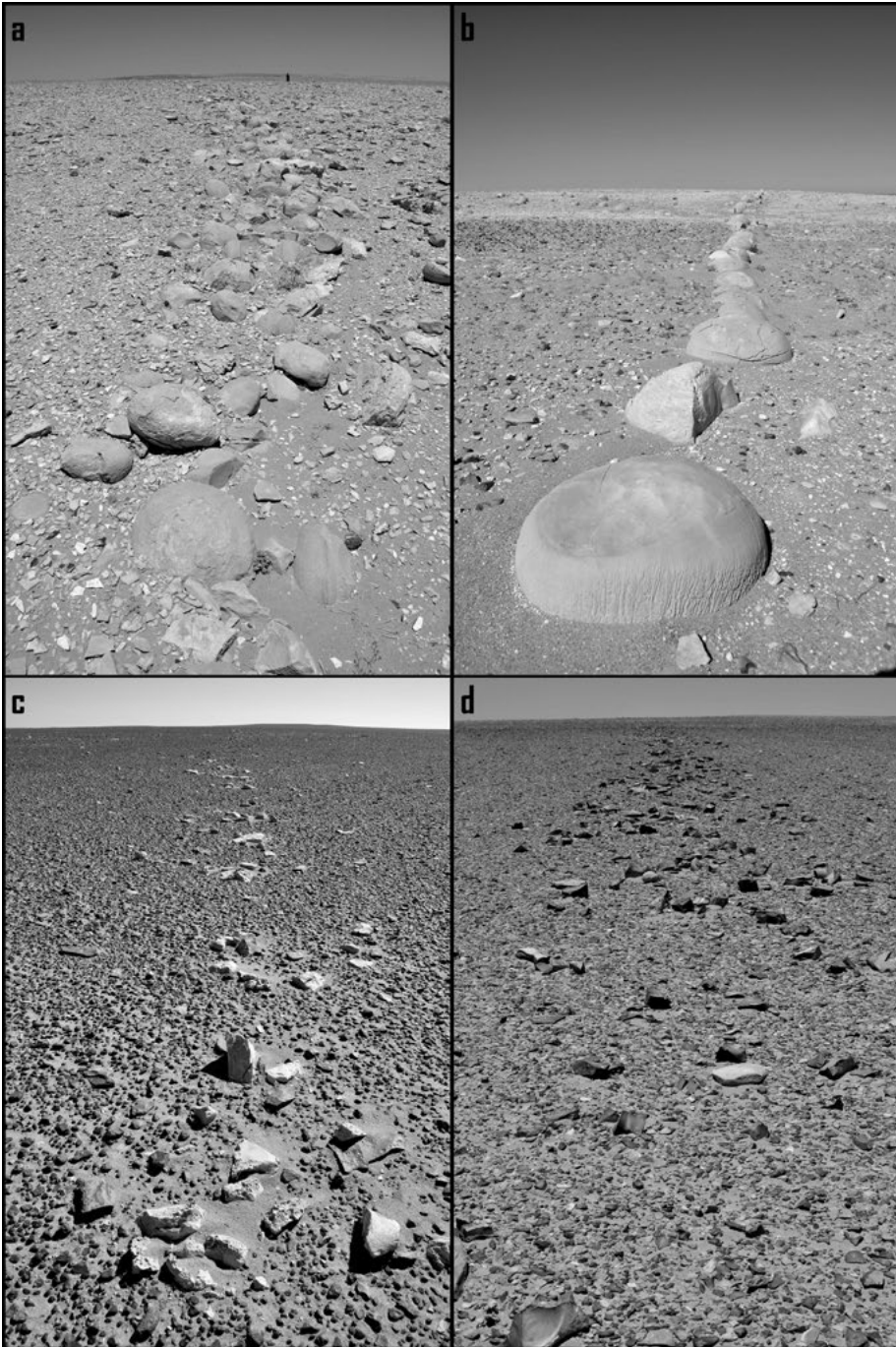


Figure 7.5. Different construction techniques used for the Jibal al-Khashabyeh kite walls.

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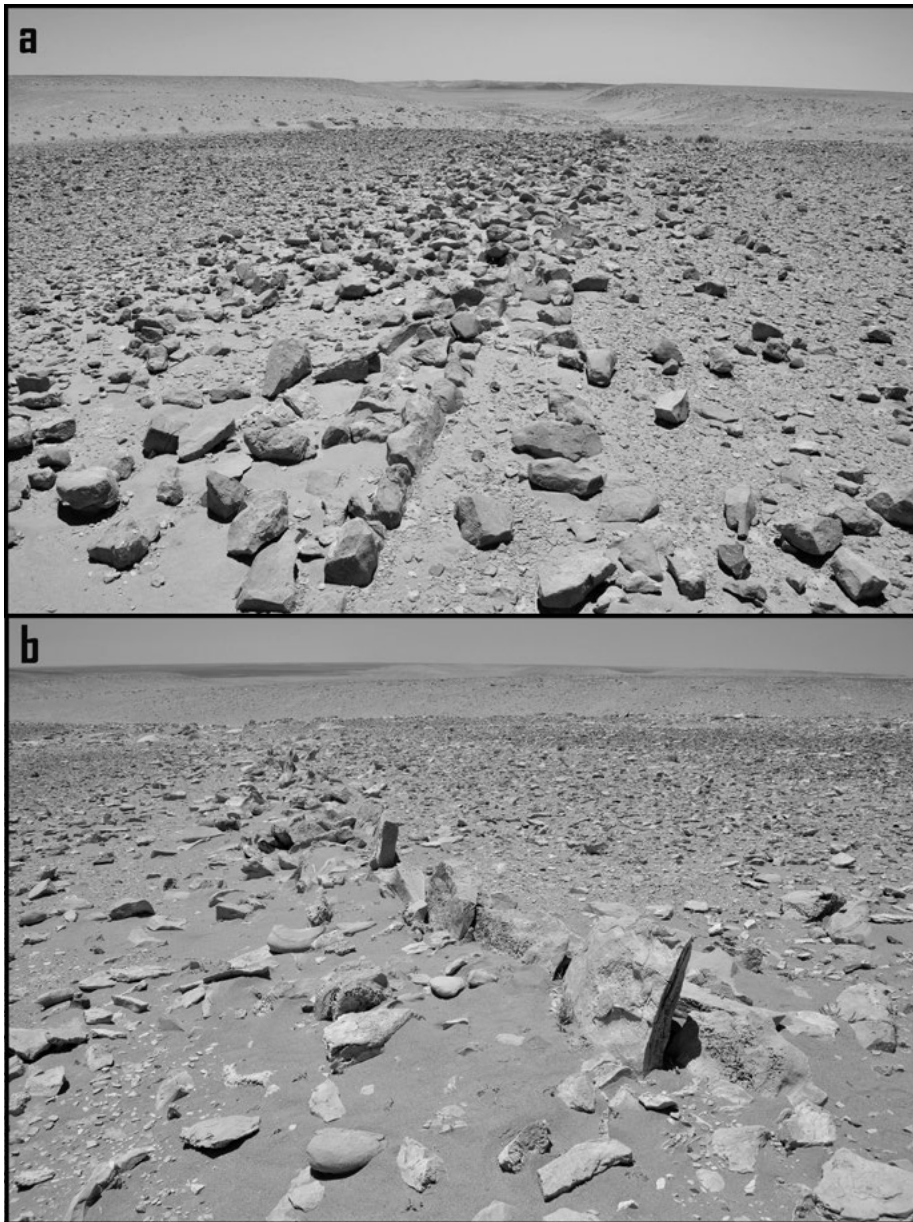


Figure 7.6. Detailed view of the construction technique of the walls at the approach of the final convergence point. Note the double-faced wall of JKSH 08 (a) and the standing slabs of JKSH 04 (b).

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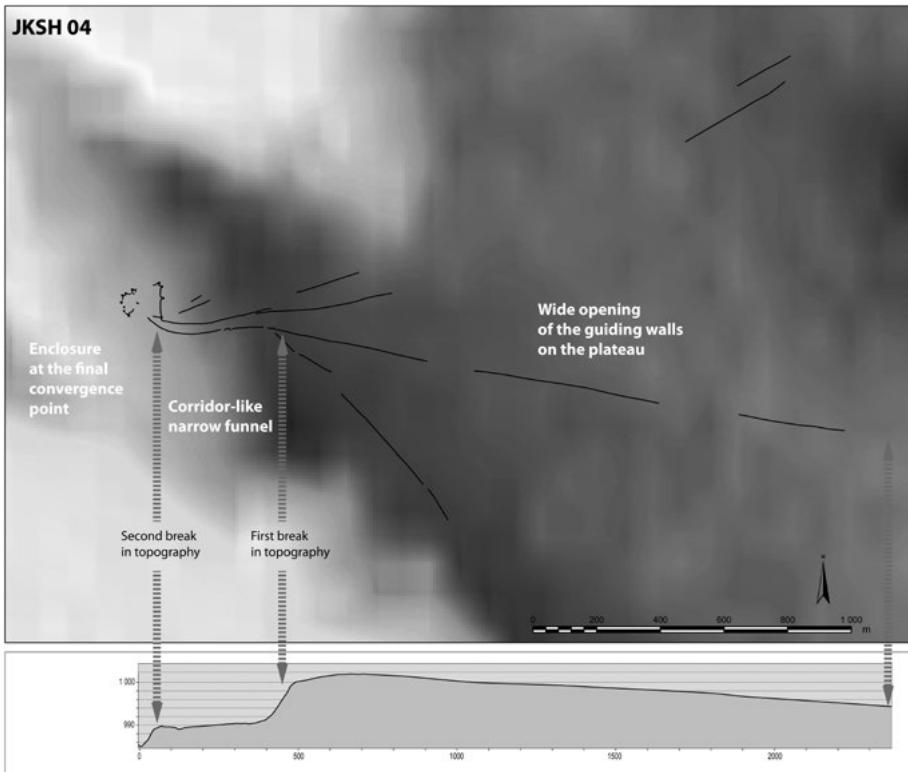


Figure 7.7. Plan and profile showing the characteristic topographical setting of the different components of kite JKSH 04. Note: the profile runs along the median guiding wall of the kite, which farther west becomes the southern wall of the corridor-like funnel.

Topographical setting

The Jibal al-Khashabiyeh kites share one essential characteristic in their use of the local topography. The drivelines have a wide flared opening to the east and converge towards the west until they reach a first smooth break in the topography of the escarpment (Figure 7.7). From this point, they form a narrow and elongated corridor that gently slopes down on the bank of the eroded escarpment. The most dramatic expressions of this layout are found at kites JKSH 07 and JKSH 08, where the corridor-like feature is more than 500 metres long and between 20 and 70 metres wide (Figures 7.3 and 7.8). Kites JKSH 01 and JKSH 04 also have this very characteristic feature. Although the corridor is slightly shorter (360 metres in both instances), it is even narrower than the previous examples, with a width between 20 and 40 metres, thus strengthening its singular corridor-like aspect (Figures 7.3 and 7.7). Another characteristic lies in the shape of this corridor, which follows a smooth curve towards the north. This curve is strongest in the final section of the corridor, at the final approach to the enclosure. This is a very

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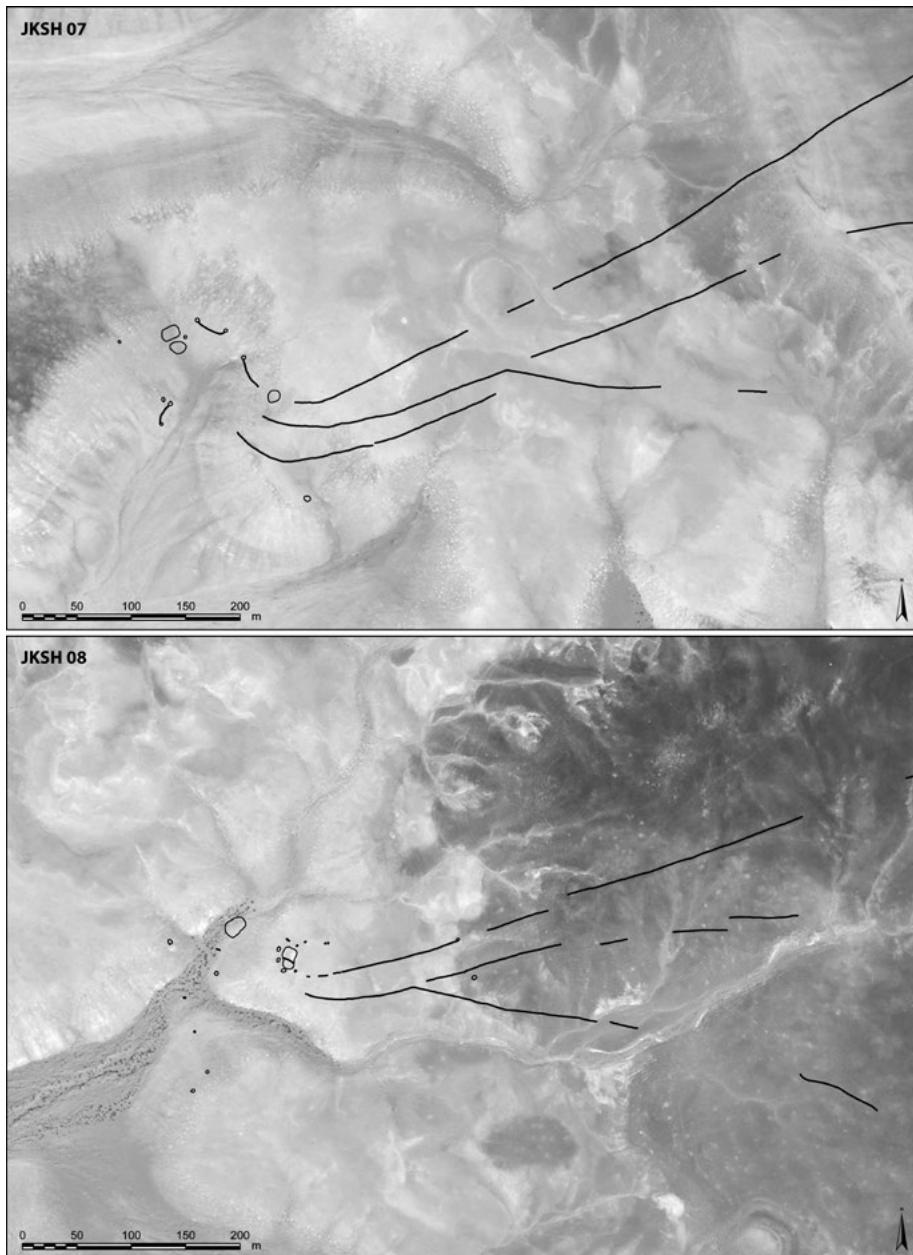


Figure 7.8. Satellite images of kites JKSH 07 and JKSH 08. (Google Earth™, Bing™ overlay; cartography by Wael Abu-Azizeh)

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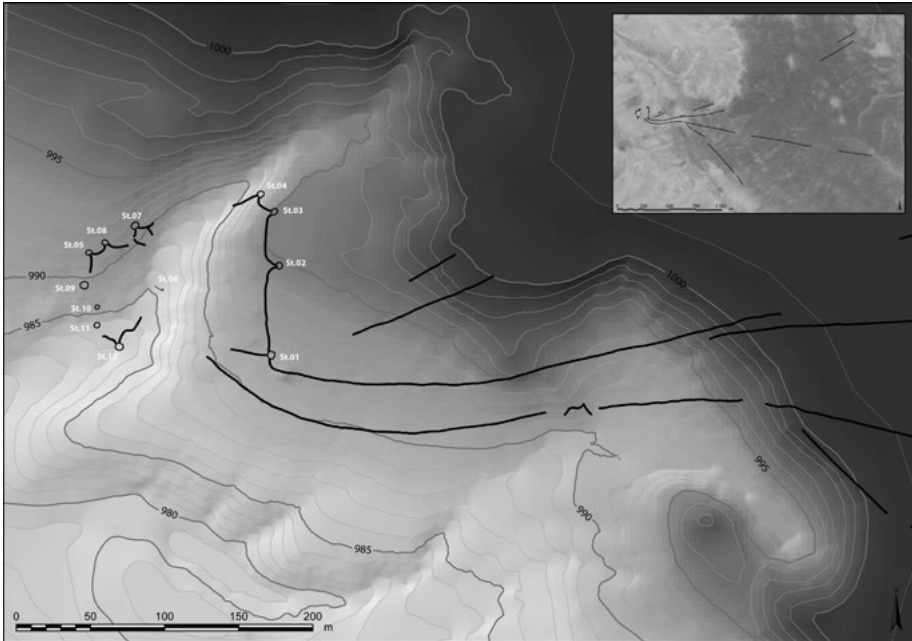


Figure 7.9. Topographical plan showing the detailed setting of the final convergence point and the star-shaped enclosure of kite JKSH 04.

singular feature that must have been significant for the correct functioning of the kites (see below).

At the end of the corridor, the final approach is characterised by a second slope that, contrary to the first one, is sometimes steep and abrupt. It is formed by the formal break and transition between the plateau and the Al-Jafr Basin (Figure 7.7). Almost systematically, the drivelines and the narrow corridor lead to a wadi that is deeply eroded in the escarpment slope. The curving shape of the corridor creates a specific configuration in which the outlet of the corridor terminates in a naturally eroded, semi-enclosed cirque or starting point of a wadi (Figure 7.7–7.9). Although, due to their location in the wadi beds, structural remains have often been destroyed in these areas, remnants of polygonal enclosures have been clearly identified in several instances. These enclosures are of the typical star-shaped plan and very similar to the ones found in the *harra*. The best-preserved example is found at kite JKSH 04 (Figures 7.9 and 7.10). Here the elongated corridor leads to a naturally eroded cirque in which the star-shaped enclosure has been set. The latter consists of a surrounding wall built with a large quantity of stones, mostly set vertically in the ground. At least eight circular features, ranging in diameter from three to five metres, are associated with this enclosure wall. They are located at the apex of the star-shape points. Both the enclosure and the associated circular features are set in the upper parts of the slopes, overlooking the erosion gully. In the sandy wadi bed, the remains of the enclosure have been totally destroyed by surface run-off.

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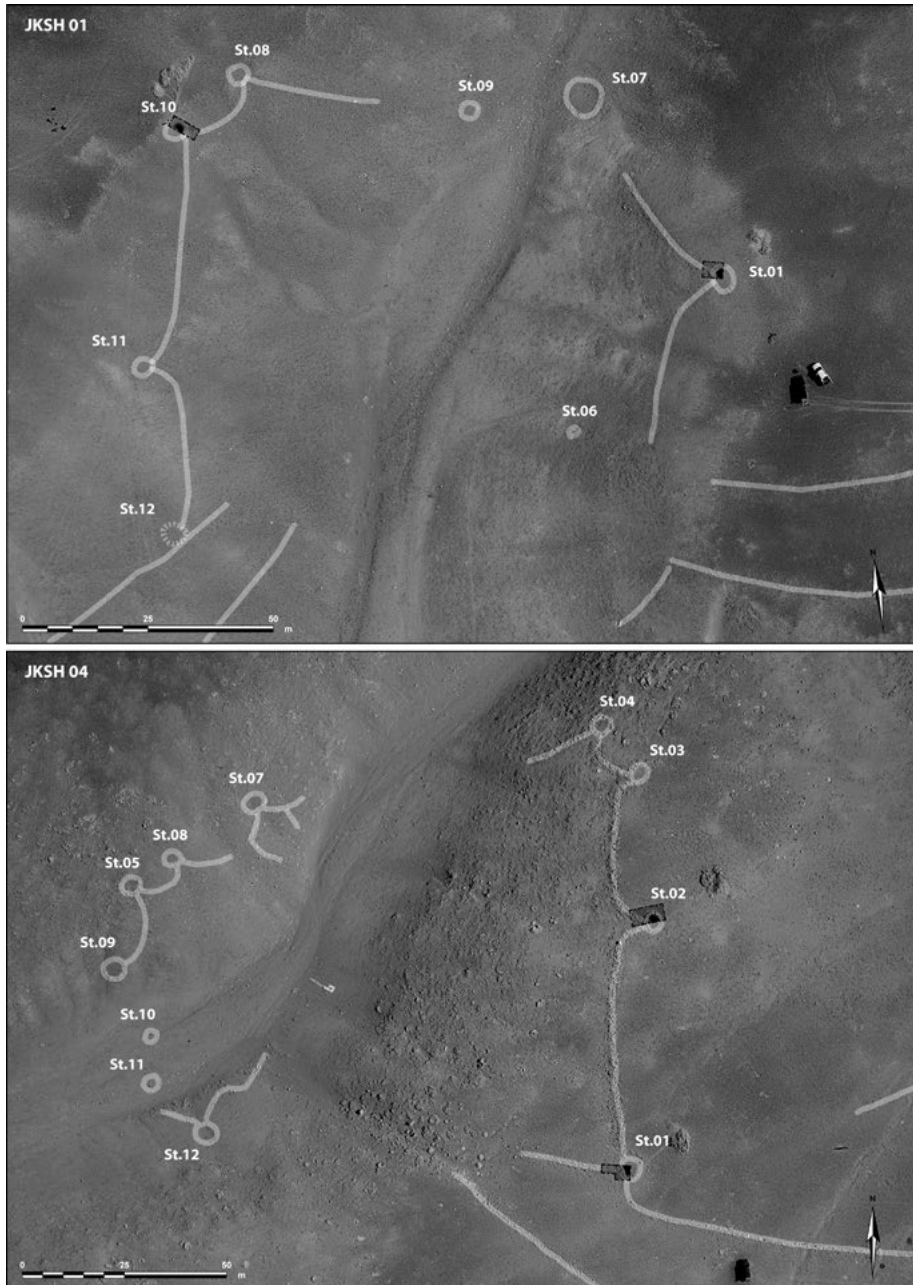


Figure 7.10. Orthophoto mosaic of the enclosure areas at kites JKSH 01 and 04, with location of excavated soundings.

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At kite JKSH 01, the situation is very similar (Figure 7.10). The narrow corridor of the kite's drivelines also leads to an erosion gully into which a star-shaped enclosure has been set. The curve made by the corridor is also similar and oriented towards the enclosed area of the cirque to the north instead of in the direction of the opening of the wadi runnel to the south. Just as for kite JKSH 04, the enclosure of this kite has been destroyed in the wadi bed, but its remains are clearly recognisable on the banks on both sides of the wadi. At least eight circular features, ranging in diameter from two to six metres, are associated with the enclosure's star-shaped wall. The distinctive aspect of this example is that the same enclosure is associated with two sets of drivelines: the main one oriented towards the east, and a second set of shorter drivelines to the west. This is an unusual configuration for which, so far, no parallels have been found in the study area. At the present stage of research, it is difficult to determine if this layout indicates a reuse of an earlier kite structure (with a changed orientation) or if it reflects a configuration that could have functioned as a single complex.

The isolated kite JGHD 02 in the Jibal al-Ghadiwiyat area also has a typical star-shaped enclosure, with at least one identifiable circular structure attached to its western point (Figure 7.4). Similar structures may have existed at the other pointed ends of the enclosure, but their remains are now completely invisible on the surface, most probably as a result of erosion.

Excavation

Although desert kites have been known for a long time and the literature about these structures is abundant, very few excavations have been undertaken to acquire solid evidence regarding their function and date, issues that have been and still are subject to controversy. One possible explanation for the dearth of archaeological research might have to do with the somehow preconceived idea of a lack of stratigraphic potential for these structures. Along with some recent work carried out by some colleagues in the Negev, north-eastern Jordan, and Armenia (Holzer et al. 2010; Nadel et al. 2010, 2013, 2015; Bar-Oz et al. 2011a; Brochier et al. 2014; Crassard et al. 2014), our investigations have put an emphasis on pioneering sounding excavations and been successful in obtaining new data to elucidate issues of function and date. A total of seven soundings were conducted on three different kites, two of which were part of the Jibal al-Khashabiyeh kite chain. Below is a short synthesis of the main results.

One interesting result concerns the architecture of both the enclosures and drivelines of the kites. The three soundings carried out at JGHD 02 were of particular interest, as two were located on the contours of the star-shaped enclosure (Trench 1 and 2), while the third sounding (Trench 3) was set on the southern driveline at a distance of approximately 100 metres from the enclosure entrance (Figure 7.4). These soundings allowed the construction technique of the walls in different parts of the kite to be studied and compared. Despite the scattered and disorganised appearance of the walls on the surface, the three soundings revealed unexpectedly fine masonry. In every location, the walls were built using the same construction technique of a double-faced dry masonry, with an internal

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filling of smaller stones and pebbles. The walls had a width between 50 and 60 centimetres. In Trench 1, one to two stone courses were preserved (Figure 7.11a), while in Trenches 2 and 3, only one course of bigger stones formed the wall facing (Figure 7.11b–d). A distinctive feature was observed in Trench 3, where the wall facing was composed of standing stones set vertically, leaving narrow spaces of a few centimetres between each stone (Figure 7.11c–d). Although the wall was built with only one course of stones, this technique provided a significant height (50 to 60 centimetres) to the construction.

The soundings undertaken in the chained kites of the Jibal al-Khashabiyeh sector confirmed that walls consisted of fine masonry, contrasting with their disorganised appearance on the surface. These soundings, which focused on the enclosure of the kites, showed that in these specific locations the construction was generally even more carefully laid; the inner facing of the wall (towards the inside of the enclosure) consisted of an arrangement of large stone slabs set on their sides, which were kept in place by the inner filling and the outer facing of smaller boulders. All in all, these results shed new light on the effort and amount of work needed for the construction of the kites.

Our excavations mainly concentrated on the circular cells or features located on the points of the star-shaped enclosures. A total of five cells were partially excavated (halves or quarters): two each in kites JKSH 01 and 04, and one in kite JGHD 02. The results of these different excavations were generally very consistent, apart from a few minor variations. The excavations showed that the cells were deeply inserted into the ground and had later entirely filled with sandy and aeolian sediments. They constitute pits dug into the natural soil, the sides of which had been entirely faced with stone masonry. In several instances it was noticed that while the upper parts of the walls were constructed using small to medium-sized stones, the base of the walls consisted of a row of bigger boulders and/or standing stones set next to each other (Figure 7.12). The bottom of the circular cells consisted either of virgin soil or limestone bedrock, thus providing a solid and stable base on which to erect the stone facing.

The cells were generally 1.5 metres deep (measured from the present-day surface), although in one instance (kite JKSH 01, St. 10) the pit was 1.8 metres deep (Figure 7.13). However, the structures must originally have been deeper still, given the significant quantities of fallen stones that were removed from the pit fill. Using photogrammetry for 3D model processing, we were able to calculate the volume of these fallen stones, which in turn enabled us to calculate the original height of the structures. The stones found in the fill of cell 01 of kite JKSH 01 had a volume of 0.65 m³, which adds an additional 48 centimetres to the preserved height of the cell. The cell would therefore have had a total depth of about two metres. Moreover, it was possible to observe that in the centre of the structure the soft limestone bedrock was dug out to add more depth (Figure 7.13). The considerable depth that has been observed for these cells sheds new light on the function of the kites.

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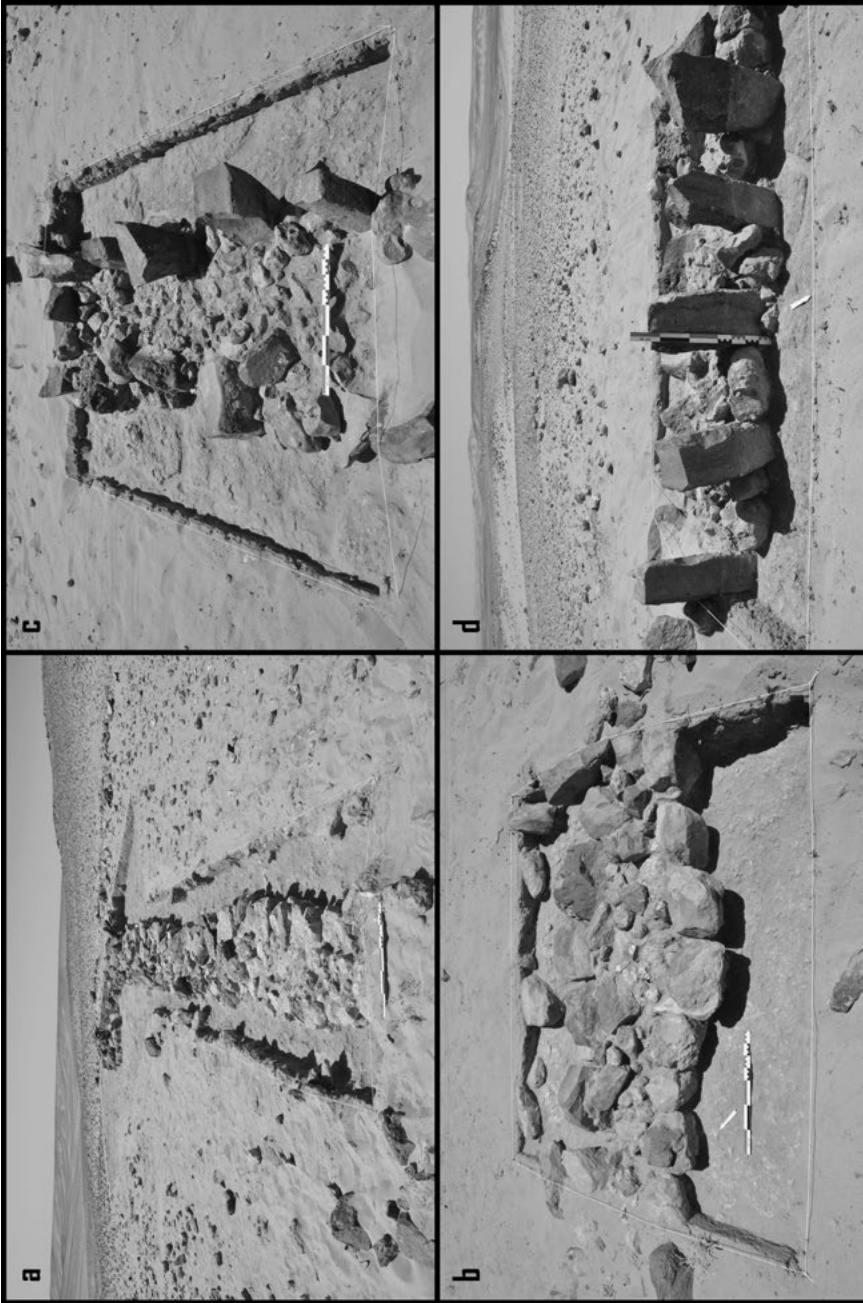


Figure 7.11. Detailed views of the double-faced wall construction of kite JGHD 02 in A. Trench 1; B. Trench 2; and C and D. Trench 3 (note the spaced standing stones providing an aspect of 'picket-fence').

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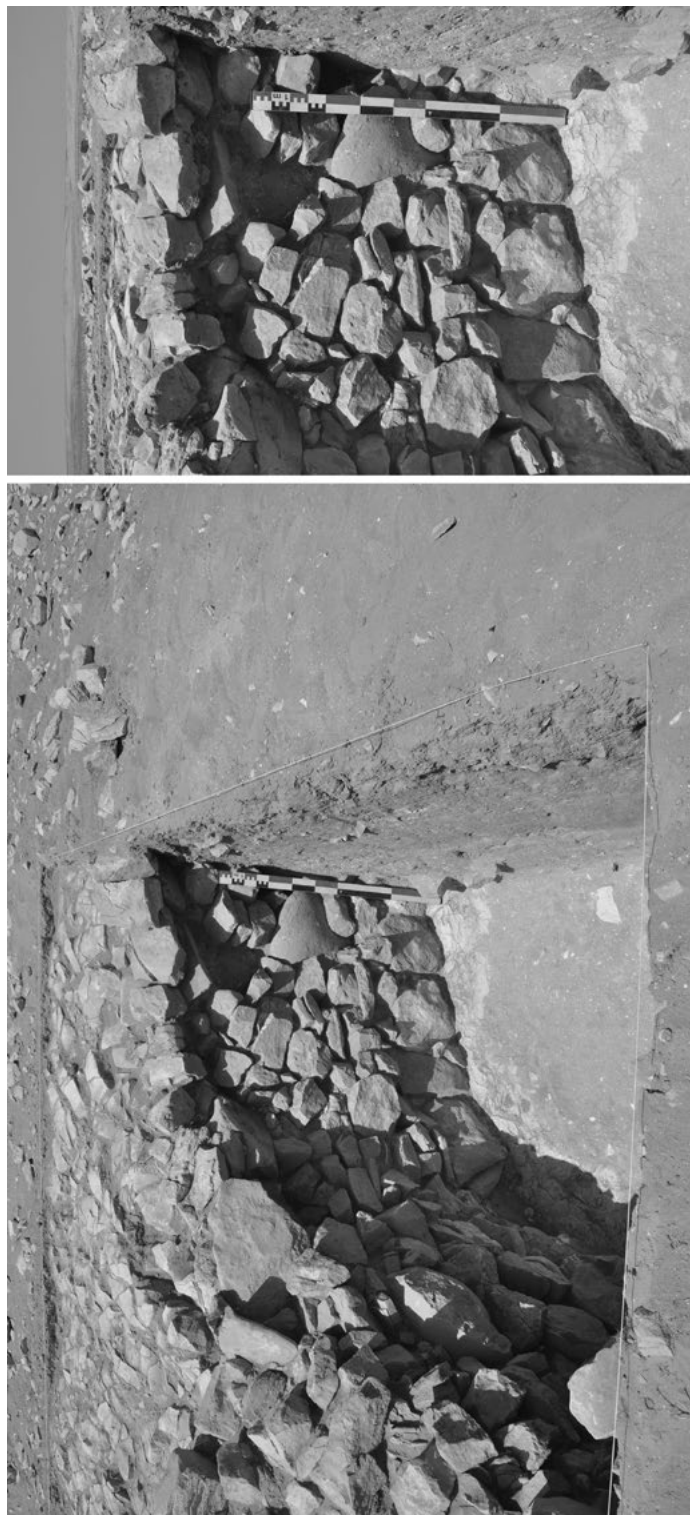


Figure 7.12. Detail of the masonry in the excavated circular structure St.01 of kite JKSH 01.

SOUTH EASTERN BADIA ARCH. PROJECT
Jibal al-Khashabiyeh 2015
JKSH 01 / St.01
Section East-West

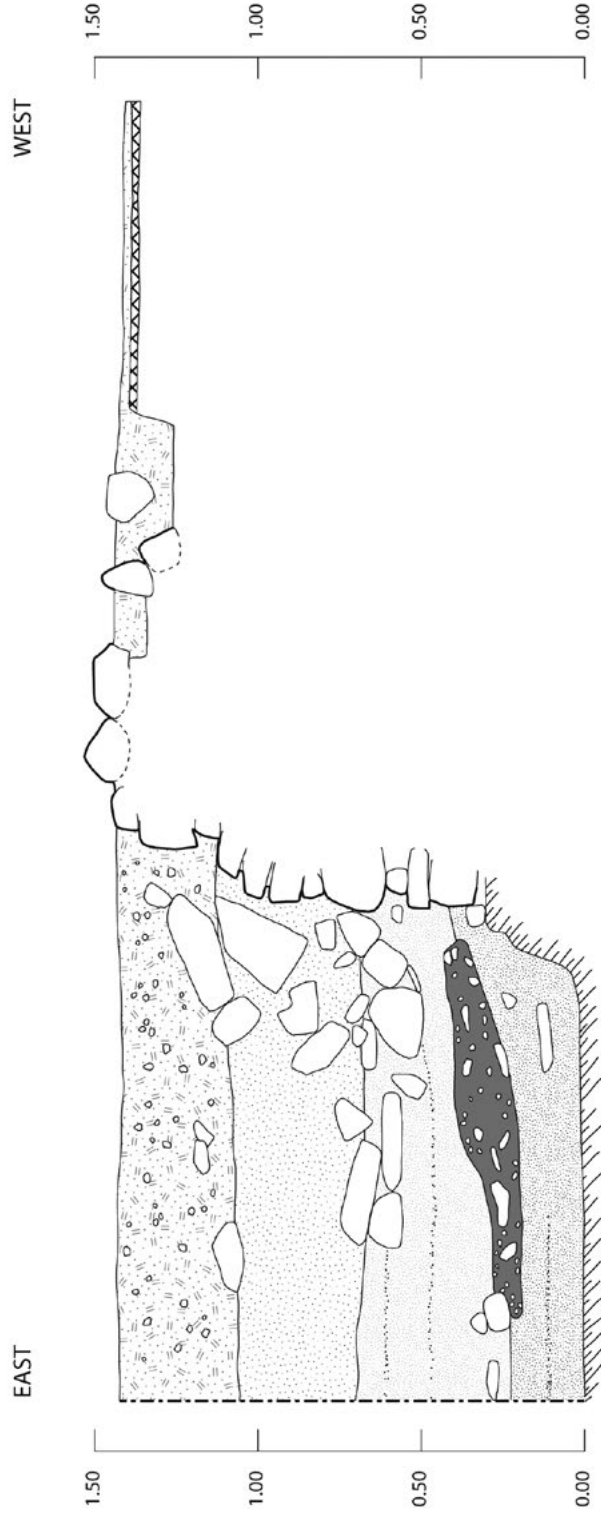


Figure 7.13. Section drawing of Trench 1 in structure St.01 of kite JKSH 01.

The function of desert kites in the south-eastern Badia

The general surface layout and organisation of the kites and the data obtained through our excavations corroborate a hunting function for these structures. Although a review of this argument has been given elsewhere and will not be detailed here (Abu-Azizeh and Tarawneh 2015), we will briefly review some of the clues that support this hypothesis.

The topographical setting of the kites provides a strong argument for a hunting function for all of the newly discovered kites in the south-eastern Badia of Jordan. The location of the drivelines on the flat and open landscape of plateaus, sometimes encompassing mud pans and water-retaining depressions, is strategic as it constitutes a perfect starting point for chasing wild animals as these tend to gather in these locations in search of water. The characteristic shape and layout of the kites is also significant. Among the specific features observed, the curving shape of the corridor feature would have meant that the terminal enclosure was hidden from view. This impression is emphasised and reinforced at kite JGHD 02, where the enclosure is located behind a low mound that renders it completely invisible from the east where the drivelines extend onto the plateau. This clever use of topography, and the construction of the enclosures on the steep escarpment of the plateau, is a clear indication that the intention was to force game onto unfavourable and insecure terrain to facilitate their capture and drive them inside the enclosure.

The hunting interpretation can be further corroborated by close scrutiny of the architectural elements of the kites. Of particular interest is that the drivelines are more elaborately constructed the closer one gets to the enclosure. While the drivelines have some gaps and are composed of only very low stone alignments on the plateau, they are much more carefully constructed at the final approach to the enclosure, where double-faced masonry is often still recognisable on the surface. In these locations, they are higher and standing stones are often used to strengthen the construction, particularly around the enclosures. It seems that these variations in the construction technique of the walls have to do with the different phases of the hunt. During the initial 'passive' phase, rudimentary stone alignments would have been enough to guide a herd of quiet and unfrightened grazing animals (see, for instance, Holzer et al. 2010 concerning gazelle behaviour and their tendency to move along linear paths and obstacles despite their ability to jump over them). Once driven inside the narrow corridor, the animals might start to feel trapped, and this would trigger the second, 'active', phase of the hunt. As they started to panic the animals would have been more inclined to jump to escape. It is certainly no coincidence that from that point (that is, in the narrow corridor and the enclosures) onwards the walls are higher and better constructed, in order to dissuade the animals from jumping over them and to keep them running along the corridor.

Finally, the most persuasive evidence is that from the excavations of the circular cells surrounding the enclosures. The various soundings all point to deep pit-like structures. This is consistent with the 19th-century ethnographic records in Badiyah ash-Sham, which describe hunting techniques in which gazelle were captured in pits associated with structures similar to the kites (see Helms and

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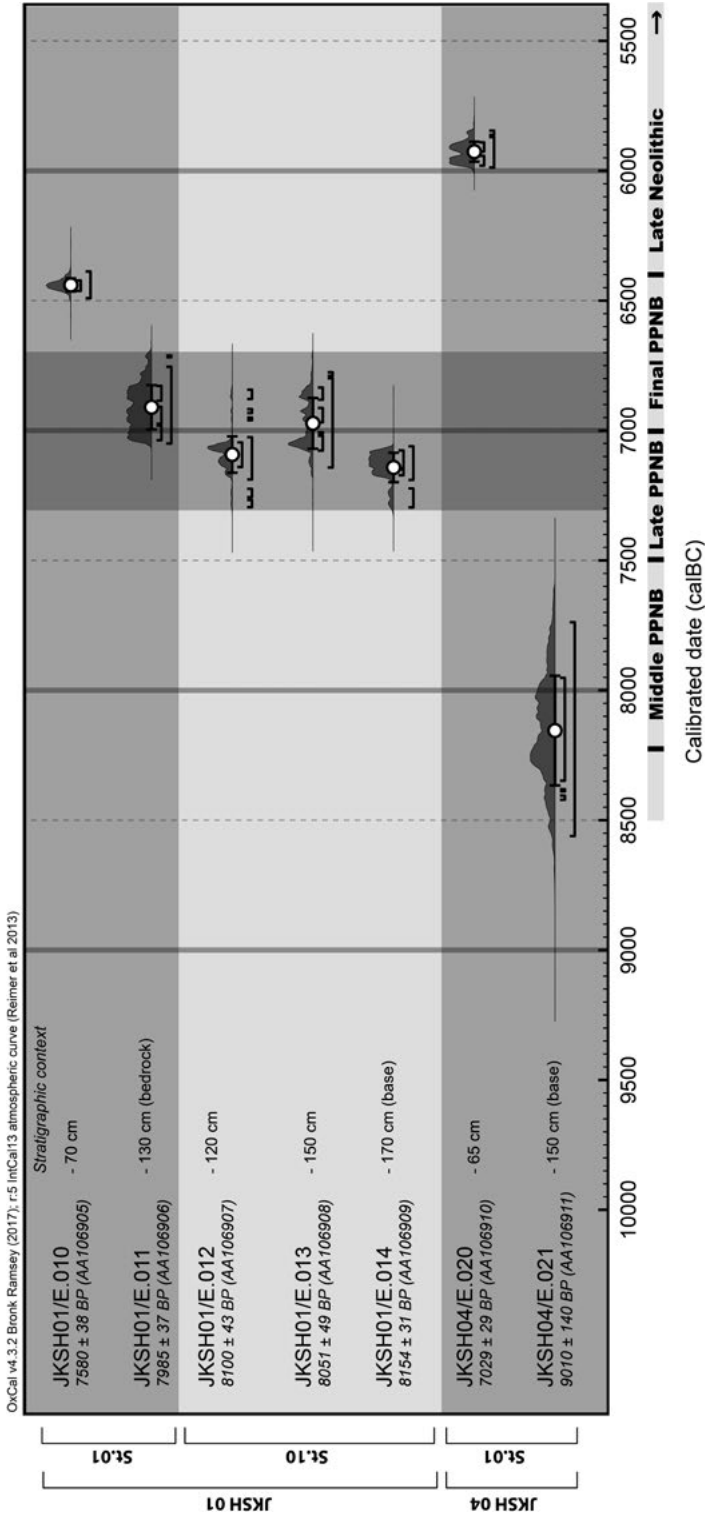


Figure 7.14. Calibration table of radiocarbon dates from Jibal al-Khashabiyyeh kites. Note that the 1σ and 2σ confidence ranges are indicated for each date by the brackets. The vertical dark grey strip highlights the consistency of the dates indicating an end of use of the kites around 7000 cal BCE.

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Betts 1987: 62–3; Betts et al. 1998: 201–5 and references therein to Burckhardt 1831: 220; Wright 1895: 42; Musil 1928: 26–37; and Chambrade and Betts, this volume). Therefore, there is little doubt that the circular pit-like structures surrounding the enclosures were the final traps of the kites. Although the question of what animal species were hunted remains open, clear similarities with the ethnographic examples make a strong case for the hunting interpretation.

The age of desert kites in the south-eastern Badia

Another major aspect of the results provided by the excavations concerns the chronology of the kites. In several instances we were able to obtain charcoal remains from the deep stratigraphic fill of the pit-like structures. These were either charcoal from small hearths, indicating a later reuse of the structures as ephemeral shelters, or fragments of residual charcoal trapped in aeolian sediments. They were obtained at different depths of the sedimentary fill and thus constitute a substantial set with which the validity of the resulting radiocarbon dating can be verified (Table 7.1 and Figure 7.14). The samples were processed for AMS radiocarbon dating at the AMS Laboratory of the University of Arizona.

The oldest date, obtained from JKSH 04/St. 01, has an age range of 8562–7739 cal BCE [2σ] (AA106911: 9010 \pm 140 BP). This sample had an insufficient carbon yield, and the resulting date with its very long time range needs to be considered with some caution as a correction was applied by the lab (Hodgins, personal communication). Four dates come from samples obtained directly at the base of the cells or from the lower sediment layers of their fill. They come from the two cell structures excavated in kite JKSH 01. These dates provided very consistent ages, ranging between 7297–6712 cal BCE [2σ] (AA106909: 8154 \pm 31 BP; AA106908: 8051 \pm 49 BP; AA106907: 8100 \pm 43 BP; AA106906: 7985 \pm 37 BP). They constitute a secure terminus for the final use of the kites during a transitional Late PPNB/Early Final PPNB timeframe, around 7000 cal BCE. The last two samples were obtained from JKSH 01/St.01 and JKSH 04/St.04 from the upper layers of their pit fills (respectively at 70 centimetres and 65 centimetres from the surface). They provided younger dates with the following respective ranges: 6491–6389 cal BCE [2σ] (AA106905: 7580 \pm 38 BP) and 5988–5846 cal BCE [2σ] (AA106910: 7029 \pm 29 BP). These younger dates are consistent with the higher stratigraphic position of the samples and confirm that the chronological sequence constitutes a coherent whole.

These results are of major importance since the dating of kites and their origin are still much debated. Betts and Helms were the first to argue for a construction and use of the kites as early as the PPNB (Helms and Betts 1987; Betts et al. 1998). This hypothesis was based on flint surface finds around and within the kites, as well as on evidence from hunting camps at the site of Dhuweila that were believed to be associated with kites. However, since then there has been very little evidence to corroborate such an early date, and it has not been widely accepted (see, for instance, the vivid debates in Betts 2014; Zeder and Bar-Oz 2014). Conversely, the growing body of evidence from more recent work undertaken on kites in Sinai and Negev, as well as in Syria, tends to support a later chronological

Table 7.1. ^{14}C calibration table of charcoal samples from J. al-Khashabiyeh ‘Desert kites’, including raw data and calibrated ranges at 1σ (68.2%) and 2σ (95.4%) confidence. Dates have been calibrated using OxCal v.4.3.2 Bronk Ramsey (2017) using Intcal 13 atmospheric curve (Reimer et al 2013).

Raw data										Calibrated range BC (calendar ages)					
Sample ID	AAID	Lab#	Material	Mass	$\delta^{13}\text{C}$ value	F ($\delta^{13}\text{C}$)	dF ($\delta^{13}\text{C}$)	^{14}C age BP	\pm	from	to	%	from	to	%
JKSH01/E.010	AA106905	X29536	Charcoal	1.82mg	-12.1 ‰	0.3892	0.0019	7580	38	-6463	6423	68.2	-6491	-6389	95.4
JKSH01/E.011	AA106906	X29537	Charcoal	1.30mg	-24.9 ‰	0.3701	0.0017	7985	37	-7038	6829	68.2	-7051	-6712	95.4
JKSH01/E.012	AA106907	X29538	Charcoal	2.28mg	-24.5 ‰	0.3648	0.0019	8100	43	-7141	7046	68.2	-7296	-6843	95.4
JKSH01/E.013	AA106908	X29539	Charcoal	1.64mg	-24.1 ‰	0.3671	0.0022	8051	49	-7078	6835	68.1	-7143	-6776	95.4
JKSH01/E.014	AA106909	X29540	Charcoal	1.97mg	-25.1 ‰	0.3624	0.0014	8154	31	-7173	7077	68.2	-7297	-7061	95.4
JKSH04/E.020	AA106910	X29541R	Charcoal	2.04mg	-11.1 ‰	0.4168	0.0015	7029	29	-5981	5891	68.2	-5988	-5846	95.4
JKSH04/E.021	AA106911	X29542L	Charcoal	0.24mg	-14.8 ‰	0.3258	0.0057	9010	140	-8422	7953	68.2	-8562	-7739	95.4

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timeframe: both absolute and relative dating methods mainly point to the 4th to 2nd millennia BCE (that is, Chalcolithic and/or Early Bronze Age) (Eddy and Wendorf 1999; Holzer et al. 2010: 812–3 and table 1; Nadel et al. 2010, 2013: fig. 4; Bar-Oz et al. 2011a: 213; Bar-Oz et al. 2011b: 5; for a comprehensive review of this evidence see also Zeder et al. 2013: 121 and table 1). However, data from the joint Italo–Syrian Project in the Palmyra steppe recently provided new evidence supporting the use of kites as early as the Late Neolithic, thereby re-launching the debate on the question of the origins of the phenomenon (Morandi Bonacossi 2014: 37). Although they constitute solid evidence, their results rely exclusively on elements of relative chronology and radiocarbon dating of cairn structures that were built on top of the kite walls.

The new data provided by our research constitutes the first direct and indisputable evidence of such an early date for the construction and use of kites in the Near Eastern desert margins. It pushes back the use of these sophisticated hunting strategies to the PPNB.

Conclusion

The results provided by our fieldwork in the south-eastern Badia shed new light on the desert kites phenomenon. Not only does the discovery of kites in this area allow a gap to be filled in the distribution of kites in the Near East, but the detailed study of their general layout and organisation, and the excavations carried out, provide information of a new kind on the function and date of such structures.

One aspect of these results that requires further attention in the future concerns the amount of work and effort that were invested in building such specialised and large-scale structures. Although the vast size of kites was already clear from aerial and satellite imagery, the excavations carried out by us provide another dimension, perhaps even more substantial, to this fascinating phenomenon. Contrary to the widely shared opinion, it is now clear that the construction of kites did not consist of a ‘simple’ piling up of stones over hundreds of metres and sometimes several kilometres. As our excavations show, proper double-faced walls were often constructed, at least in and near to the terminal enclosures. In practical terms this means that hundreds of metres of wall had to be carefully constructed with stone facing, internal filling, and standing stones arrangements. The human labour and effort involved comes into focus even more when the construction of the circular cell structures surrounding the enclosures is considered. These, too, involved a massive effort, consisting of removing many cubic metres of natural compacted sediment, gathering sufficient quantities of stones, and setting them carefully as a masonry facing for the cells. Knowing that each kite would probably have had a minimum of at least six such circular pits (kite JKSH 04 has at least eight, with three additional missing cells), the construction of each kite would have constituted a real challenge.

However, kites required more than a concerted action for their construction. They also required many hands for the hunt itself and finally also for the processing of the spoils. The communal dimension embedded in the construction and use of the kites is all the more compelling since our results indicate that the origins of

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these specialised hunting strategies date back as far as the PPNB period. These results, therefore, have a far-reaching significance for our understanding of the socio-economic and political organisation of the Near Eastern desert margin at such an early period.

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