

Walls, ramps and pits: the construction of the Samar Desert kites, southern Negev, Israel

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Archaeological investigations of 'desert kites' in south Israel show them to have been animal traps of considerable sophistication and capacity, constructed in the Early Bronze Age or earlier. Extensive stone-wall arms gather in gazelles from their habitual trails and canalise them into a sunken enclosure, cunningly hidden from view of the galloping herd until it was too late. . .

Keywords: Israel, Levant, Early Bronze Age, hunting, trapping, animal management

Introduction

The way in which mid Holocene societies perceived, treated and manipulated their landscape included, for the first time, the construction of numerous large-scale stone features away from their villages and campsites. Falling within this new sphere of construction and modification

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of the landscape in the Near East are the huge linear stone alignments, termed 'desert kites'. These are large triangular-shaped features, built of two long converging stone walls with a circular enclosure at the apex. They were first noted from the air nearly a century ago (Maitland 1927; Rees 1929) and termed 'kites' due to their shape. The enclosure can range from a few metres to over 100m in diameter and the walls (arms) may extend for hundreds of metres and even several kilometres. The walls are constructed of local stones of varying sizes.

Ethnographic examples indicate that many of the desert kites were used for communal hunting, the latest evidence for this is provided by accounts written in the nineteenth and early twentieth centuries (Burckhardt 1831: 220–21; Musil 1928: 26–7; Aharoni 1946: 31–3). Such large-scale hunting and trapping techniques are known from many parts of the world, including northern Europe (Barth 1983), central Asia (Yagodin 1998), North America (e.g. Frison 1991, 2004; Hockett & Murphy 2009; O'Shea & Meadows 2009) and South Africa (Coon 1976: 111–15). Thus it has become accepted that the Near Eastern desert kites were used mainly for trapping wild ungulates (reviewed in Rosen & Perevolotsky 1998; Betts & Yagodin 2000; Meshel 2000; Holzer *et al.* 2010). Some large-scale desert constructions from Yemen were recently published (Bruner 2009). These appear to include a variety of types, some of which may have functioned in a different way to the kites discussed here. It is also important to note that some desert kites were interpreted as systems used for corralling domestic herds (goats and sheep) at times of raids (Rees 1929).

The earliest date for a desert kite was claimed for a site in eastern Jordan, with a tentative assignment to the Pre-Pottery Neolithic B period (eleventh to ninth millennia BP, all dates calibrated; Helms & Betts 1987; Betts 1998; see also Legge & Rowley-Conwy 1987, 2000). However, only a few kites have been directly radiometrically dated. In some areas, like the southern Levant, *in situ* material remains and animal bones are very rare.

The kites found in the Trans Jordanian deserts are very large, sometimes comprising long chains encompassing tens of kilometres (Rees 1929: 398; Helms & Betts 1987; van Berg *et al.* 2004). At the other end of the scale are the kites of the Negev and Sinai deserts (Meshel 2000; Holzer *et al.* 2010). These are usually only 50–150m long, mostly isolated, and never a component of long continuous chains.

Archaeological studies of the Syrian and Jordanian kites provide details regarding their structure, type, topographic setting and distribution patterns (Helms & Betts 1987; Echallier & Braemer 1995; Betts 1998; Betts & Yagodin 2000; van Berg *et al.* 2004). While chain kites are thought to have been used to trap the large migratory herds of the Persian (goitered) gazelle (*Gazella subgutturosa*), the smaller and isolated Negev and Sinai kites were probably built to trap small numbers of non-migratory local herbivores that grazed in small herds (e.g. Dorcas gazelle [*Gazella dorcas*], onager [*Equus hemionus*] and Arabian oryx [*Oryx leucoryx*]). Species and herd size may have determined the location and dimensions of the traps. The topographic settings of some kites in the Negev and Sinai suggest that animals were approached while grazing in a pasture area, driven into the funnel-shaped arms of the nearby kite, and then frightened over a drop or into a small enclosure. Several of the Negev and Sinai kites have been subjected to a variety of archaeological, zoological and ecological studies (Avner 1972; Meshel 1974, 2000; Perevolotsky & Baharav 1991; Rosen & Perevolotsky 1998; Holzer *et al.* 2010). However,

the majority of the known Negev and Sinai kites have only been surveyed and mapped (Bar-Oz *et al.* 2009; see also Meshel 2000 and references therein), and just a few have been excavated and published (Kobusiewicz 1999; Holzer *et al.* 2010). Our renewed project included a detailed and systematic survey of all 11 Negev kites, and excavations at four of them.

Following is a report of our work at the two adjacent kites of Samar: Samar West A and B (hereafter SWA and SWB respectively) in the southern 'Araba Valley, Israel (Figures 1ba & b, 2). We excavated several trenches at each of the kites, focusing on the

enclosure at the apex (head). The results of this study, and previous excavations at a third nearby kite: Samar East (Holzer *et al.* 2010), provide new insights regarding the construction of the kites, their dates, their role in the subsistence of past desert people and their impact on the landscape.

The Samar kites

The Samar kites are located on a plain, 1.5km south of the Yotvata acacia savannah and a few kilometres north of the Evrona basin (Figure 1b). Kites SWA and SWB (Figure 1a, nos. 11 & 12) are located adjacent to one another as already observed and reported (Rothenberg 1967: 290; Avner 1972; Meshel 1974, 2000). The Samar East kite is situated *c.* 1.2km to the east. The arms of the two adjacent kites (SWA and SWB) end only a few metres from one another, together forming a 'W' pattern, open towards the acacia savannah to the north. The western arm of SWB starts below a slope of a steep hill. Together, both kites block the south-western outlet from the rich Yotvata pasture area (Figures 1ba & b, 2). The possibility that the three kites were part of a chain, partially obliterated by



Figure 1a. Map showing the location of desert kites in the Negev and north-east Sinai. Each kite is presented as a 'V', with the orientation of the arms in relation to the head: 1) Nahal Horsha North; 2) Nahal Horsha South; 3) Ein Qadis; 4) Wadi Qadis; 5) Jebel 'Arif al Naqa; 6) Pitam; 7) Harut; 8) Nahal Eshel; 9) Mizpe Sayarim; 10) isolated wall, maybe unfinished kite, north-west of Givat Samar; 11–12) Samar West B and A; 13) Samar East; 14) Jebel Hamra; 15) Giv'at Shehoret; 16) Har Shahmon.

the modern kibbutz (Samar), was considered. However, old pre-kibbutz photographs were examined and no additional kites were observed. Approximately 1km to the north-west there is an isolated additional wall (*c.* 60m long, Figure 1bb). Its construction characteristics are the same as those of the kites, both in terms of method (see below) and the setting on a flat terrace leading into a wadi bed. It may be an unfinished kite, although no further evidence is present. It should be noted that gazelles still use the trails on the south-western edge of the Yotvata savannah, most of which cut through the kites SWA and SWB (Figure 1b).

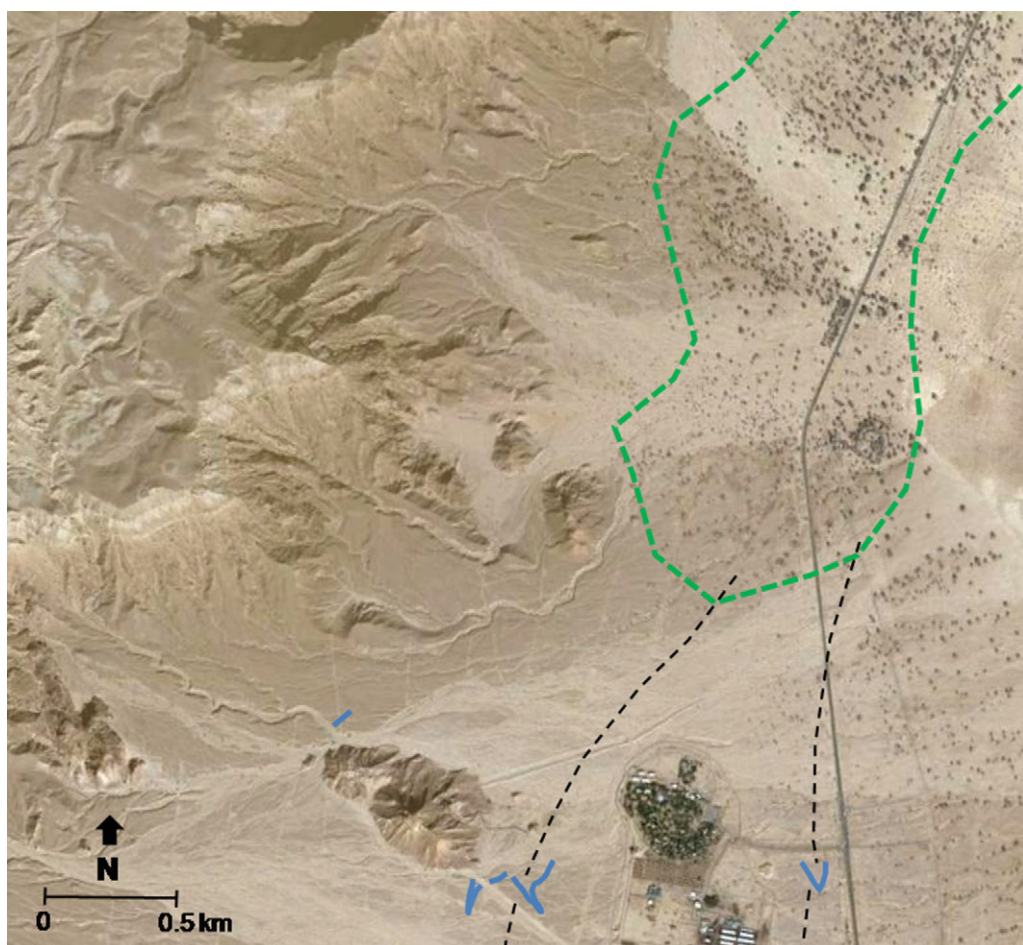


Figure 1b. The Samar kites and the Yotvata acacia savannah. Note the current extent of the savannah (green), the three kites and the isolated wall to the west (blue) and some of the animal trails (black). The modern kibbutz of Samar is visible between the kites.

Each of the studied kites is composed of three major elements: the *arms* leading the chased game into the trap, the small deep *enclosure* at the apex into which the animals were forced to jump or fall, and – no less important – a natural, vertical drop between these two elements, enhanced by the constructors with a *ramp*. In the three Samar kites, the arms are set on a flat terrace, while the head is built in a shallow wadi bed.

Samar West B

The head of kite SWB was constructed in a dry, shallow bed, about 1m below the terrace on which the arms were constructed (Figures 2–4). The enclosure itself is round, with a north–south diameter of 4.5m. It is encircled by a wall made of massive stones, preserved to a height of 4–5 courses (1.2m). Excavation of several loci within and around the enclosure,

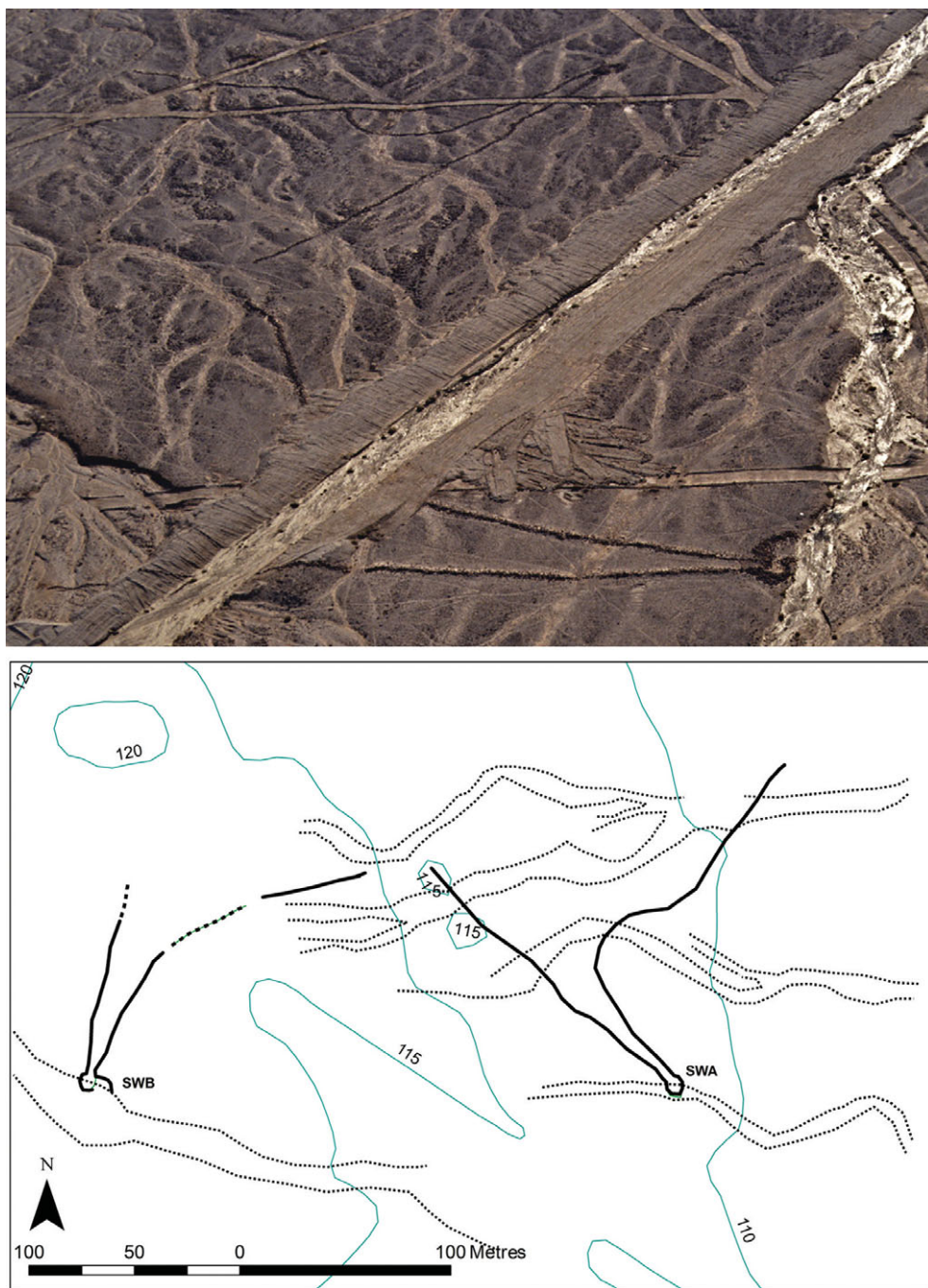


Figure 2. Top) aerial photograph of the Samar West kites. SWB is at the bottom and SWA at the top (looking east). Note modern dirt roads and modern channel cutting the arms of both kites; bottom) plans of kites SWB (left) and SWA (right). Note the flat topography, the proximity of the two kites and their openings to the north. The heads of the two kites were built in shallow wadi beds, and the arms of SWA cross several very shallow channels. Modern dirt roads and constructions are omitted.



Figure 3. General view of kite SWB, looking north along the kite. The enclosure is in front on the left (in front of the two long arms), with the later open wall on the right. The Yotvata acacia savannah is in the background, and the hills on the left (see Figure 2).

revealed its three construction phases. In the first, a bowl-like depression was dug in the wadi bed, c. 6m in diameter and c. 1m deep, including a vertical cut into the northern wadi bank. In the second, the enclosure wall was built of boulders. In the third, a ramp was built on the terrace, just above and to the north of the enclosure. The latter is fully preserved, $3.5 \times 3\text{m}$ in area and rising 0.5m above the surrounding ground. Only later were the kite's arms constructed on top of the ramp and extended to the north. The ramp was made to enhance the enclosure's depth and to hide the head of the trap from the eyes of the driven game (Figures 4 & 5).

The arms of the kite converge from the north and north-east running perpendicular to the wadi where the head was constructed (Figure 2). The eastern arm is curvilinear, beginning a few metres from the western arm of the adjacent kite (SWA). The western arm is basically straight, and it begins near the slope of a steep hill. Thus, the two kites together form a west-east barrier beginning at the foot of the hill. Together with the hill, the kites enclose an area c. 1km wide. If the isolated wall to the north-west of the steep hill is an unfinished kite or a driving wall, then the entire complex may have been much wider.

The arms were built of local stones, many of which are still *in situ* (Figure 6). The most common building method was to place large stones in a tight row, or in two parallel rows,



Figure 4. The built ramp of kite SWB, looking south as would be seen by an animal driven between the arms. The enclosure itself is hidden behind the ramp, though only 6m from the photographer. Note the large boulder set on edge incorporated in the western wall at the beginning of the ramp (centre-right of the photograph).

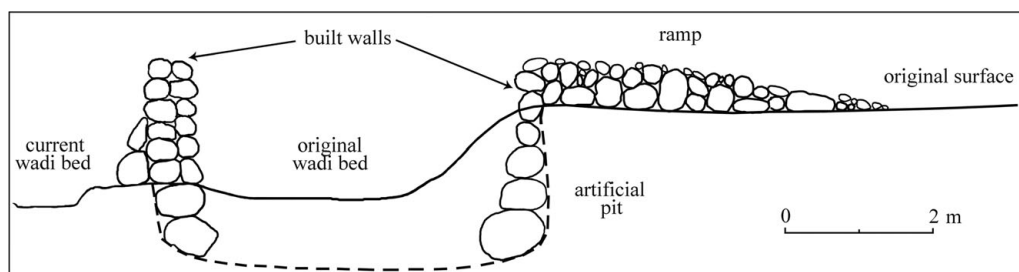


Figure 5. A schematic north-south cross-section through the head of kite SWB, showing three constructions phases: the digging of a wide pit; the construction of the enclosure walls inside the pit; and the construction of the ramp. The kite's arms were built on top of the ramp (not presented here).

to which a second and sometimes even a third course was then added. A few smaller stones were sometimes placed between the larger ones but the final construction was not a solid wall. Indeed, there was no need for additional consolidation – a clear and firm line of stones, 2–3 courses high was the desired outcome, and here remained *in situ* for millennia.

A second method of construction was to place elongated stones parallel to each other, laid in 'headers', i.e. with the long axis of the stones set perpendicular to the wall. In several locations, sections built using this method are preserved to a length of 1–3m. A third method was to set on edge exceptionally large boulders, sometimes 0.6–0.8m high. In several cases small stones were placed under their base to ensure stability. Of particular interest is a large



Figure 6. Preserved segments of the constructed walls along the arms of kite SWB as viewed from ground level (top left and right), and from a 5m pole (bottom left). A stone was set on edge and incorporated into the western arm near the ramp (bottom right) (scale bars = 1m).

stone (c. 0.8m high) set at the beginning of the ramp leading to the enclosure (Figures 4 & 6, bottom right). Additional isolated tall stones are found along the walls. Their original function is unknown but it may have been to provide a higher average line of the wall (with tall stones every 20–40m), thus creating a wall high enough to discourage the animals from jumping over. Similar large vertical stones were also observed in other kites (see below).

Dating

Post-depositional processes filled the enclosure with fine fluvial sediments (accumulating in the enclosure during flash floods) as well as with aeolian dust (Ginat *pers. comm.* 2008). A large curved wall was built near the enclosure (after most of the natural infilling had taken place) by dismantling its eastern side. The remains of a hearth were found by the new wall. Though a large volume of sediment was excavated and thoroughly sieved (2mm mesh), no bones were recovered and only a few flint implements were recovered, including eight lunates (Figure 7). They represent a late phase of kite use when the floor of the enclosure was already filled with sediment (0.3–0.4m thick); or a post-kite phase, when people used the site for camping or other activities. The lunates are all less than 20mm long, complete or only slightly broken, some with impact fractures (typical of arrowheads). Lunates are not only a Late Epipalaeolithic (Natufian) product. They were found *in situ* in other kites



Figure 7. Flint lunates found during the excavation of the enclosure of kite SWB (scale in cm).

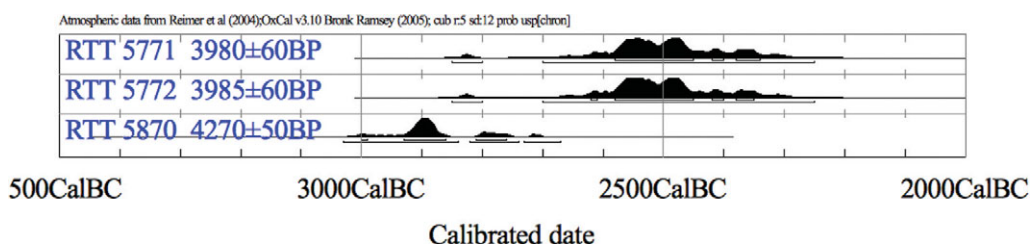


Figure 8. Probability distribution of three radiocarbon samples from the Samar kites.

(Samar East and Sinai kites, Hershkovitz *pers. comm.* 2008), and at a variety of desert sites dating from the fifth to the third millennia BC (Chalcolithic to Early Bronze Age). Charred plant fragments were common in the enclosure, in the same level as the lunates, both finds post-dating the kite's construction. Radiocarbon dating (RTT 5870) gave a calibrated range mostly in the early third millennium, with 90.2% probability in the interval 3030–2740 BC (Table 1, Figure 8). This range includes the Early Bronze Age I and II (procedure as in Yizhaq *et al.* 2005).

Samar West A

The head of SWA was built similarly to SWB, in a shallow wadi bed and in the same three phases of construction. Here, however, the ramp is barely visible due to the construction of a large tumulus tomb at the apex of the kite's arms (Figures 9 & 10). The ramp is still evident, based on some visible stones below the tumulus and on a slight rising gradient to the north. Without a ramp the vertical height difference between the running plain and the bottom of the enclosure would have been less than 1m. As is the case for the enclosure of SWB, fine fluvial and aeolian sediments accumulated inside to a height of *c.* 0.6m. Though

Table 1. Radiocarbon dates of wood charcoal samples collected from the Samar kites. Radiocarbon age given with ± 1 standard deviation, calibrated ranges given with $\pm 1\sigma$ and $\pm 2\sigma$. Calibrated ages were obtained using OxCal 3.10 (Bronk Ramsey 1995, 2001) and the terrestrial calibration dataset (Reimer *et al.* 2004). Where distinct intervals were possible for the calibrated ages, they are given with their probability. Stable carbon isotopes ratio indicates that the plants were all C3.

RTT #	Type	Age ^{14}C year BP	Calibrated age $\pm 1\sigma$	Calibrated age $\pm 2\sigma$	Collection site	$\delta^{13}\text{C}$ ‰PDB
5771	charcoal	3980 \pm 60	2580 BC (58.8%) 2450 BC	2850 BC (1.4%) 2800 BC	SWA, tumulus built above the kite, loc. 2, 9.28–9.42m	–26.8
			2420 BC (3.3%) 2400 BC 2380 BC (6.1%) 2340 BC	2700 BC (94.0%) 2250 BC		
5772	charcoal	3985 \pm 60	2620 BC (1.2%) 2610 BC	2850 BC (1.7%) 2800 BC	SWA, tumulus built above the kite, loc. 2, 9.28–9.64m	–26.0
			2580 BC (59.2%) 2450 BC 2420 BC (2.6%) 2400 BC 2380 BC (5.2%) 2350 BC	2700 BC (93.7%) 2250 BC		
5870	charcoal	4270 \pm 50	3000 BC (0.9%) 2990 BC	3030 BC (72.9%) 2840 BC	SWB, loc. 1, sq. E10, 5.30–5.38m	–25.2
			2930 BC (53.8%) 2860 BC 2810 BC (13.5%) 2760 BC	2820 BC (17.3%) 2740 BC 2730 BC (5.2%) 2670 BC		



Figure 9. Kite SWA (viewed from a 10m high crane, looking north-west). The enclosure is in the foreground, with its eastern half excavated. Above it is the tumulus, and behind are the two arms. Note the curvature of the arms (especially the left arm), see also Figure 2.



Figure 10. The wall of the enclosure of kite SWA after clearance of collapsed stones. Left) a top view (looking east) showing the width; right) the inner face of the southern wall (looking south) after excavation (scale bars = 0.5m).



Figure 11. Preserved segment of an arm of kite SWA. Stones of various sizes were used to construct the wall to a minimum of three courses. Note the similarity to SWB shown in Figure 6 (scale bar = 0.5m).

a volume of 3.5m^3 was excavated and thoroughly sieved, no cultural material remains were found.

The kite's arms run diagonally to the course of the wadi where the enclosure was built (Figure 2). They are very different from one another: the eastern arm runs in a wide curve while the western arm is almost straight. The two arms converge to form a narrow neck towards the enclosure. The arms were built of local stones, in the same methods described for kite SWB (Figure 11). Interestingly, two large boulders were set on edge (less than 0.5m from one another) and incorporated into the western wall, just a few metres from the enclosure. This setting is very similar to the vertical boulder on the western arm of kite SWB, again near the enclosure. A third case of two such boulders near the entrance was reported from the Wadi Romythi kite, in north-east Sinai (Kobusiewicz 1999: fig. 10–4; site Sinai-10). These led Kobusiewicz (1999: 180) to interpret the kite as a ritual site (the site was first published as a kite by Avner, 1972).

The tumulus evidently post-dates the use of the kite. It was built from the kite's large stones at the narrowest part of the arms, just above the enclosure. The tumulus has an outer diameter of 6.5m and is 1.5m high. Excavation inside the tumulus revealed a stone chamber, filled with collapsed stones and dust. A flagstone was found set vertically in it

which most probably served as a standing stone (*massebah*). Nearby were 86 human bone fragments (three adults). Also found were 13 cattle (*Bos taurus*) bones, a copper nodule, 10 fance beads and two bead fragments made of cowry shell (D. Bar-Yosef Mayer, *pers. comm.* 2008). Two ^{14}C dates (RTT 5771 and RTT 5772) are now available from the tumulus. The samples provided good quality charcoal with more than 60% recover after pre-treatment and 70% carbon in the measured material. The dates are indistinguishable within their standard deviation (Table 1, Figure 8). Since we cannot exclude old wood effect, a cautious interpretation of the age would best consider the $\pm 2\sigma$ range which provides a large interval for both dates, 2700–2250 cal BC, again within the Early Bronze Age. Therefore, the kite predates the mid third millennium BC.

Samar East

Samar East (hereafter SE) is the smallest of the three kites in terms of arm length (Figure 2). It was discovered by Avner (1972: 221) and excavated during three short seasons prior to the current project (Avner 1982; Holzer *et al.* 2010). On top of the kite's head a habitation unit was built, utilising most of the enclosure's stones and even the nearest parts of the arms. Nevertheless, the kite's plan is still clear. The enclosure is circular with an inner diameter of 5.5m. It is preserved to its original height (1.15m) on its northern side, while only the lowest course of the remaining perimeter was left *in situ*.

The arms are open to the north and converge to the south, running perpendicular to the wadi bed where the enclosure was constructed. They are built of local stones, although using a less intensive method than that employed to construct the arms of the two western kites. In some segments the walls are preserved with only one row of stones and only one course high. In addition, the southern portions of the arms, extending 20m and 25m from the kite's head, are completely missing, presumably due to secondary use of the stones for the later habitation compound (Holzer *et al.* 2010).

Excavation of the compound's living level yielded bones of domestic sheep and goats, flint implements, pottery sherds of hole-mouth jars, Red Sea shells, shell beads, fragments of ostrich eggshells, a copper awl, three flint lunates and two olive stones. The finds and three ^{14}C readings, ranging from 2700–2300 cal BC (Holzer *et al.* 2010: 5), indicate that those who built their compound on top of the kite were Early Bronze Age herders.

Discussion

The cultural history of the southern Negev and 'Araba Valley has been reconstructed on the basis of extensive surveys and excavations. Hundreds of sites were recorded in the 'Araba and nearby 'Uvda Valley (Rothenberg 1995; Avner 1998, 2002, 2006, 2008 and references therein). There is ample evidence for a continuous occupational sequence from the Pre-Pottery Neolithic period onwards (eleventh millennium BP; see Avner 2006: tabs. 5 & 6). The desert societies of the Negev and 'Araba were well adapted to local conditions. While in the fertile Mediterranean zones to the north cultural changes are discernible throughout the sixth to third millennia BC (Late Neolithic, Chalcolithic and Bronze Age), the desert societies show cultural continuity, with gradual, important evolution. By *c.* 6000 BC they

adopted farming, which they later greatly developed (Avner 1998, 2002: ch. 2); they also adopted goat and sheep herding as a primary means of subsistence (Rosen *et al.* 2005; Babenko & Khassanov 2007). During the fifth millennium BC they developed copper mining and smelting (Rothenberg 1990, 1995; Avner 2002: ch. 3; Levy *et al.* 2002). These developments found their expression in the constant growth of the desert population, which reached a climax in the third millennium BC. In addition, from c. 6000 BC onward, hundreds of ritual sites and installations were built in the region, representing a rich and complex spiritual aspect to local desert societies (Avner 1984, 2001, 2002: ch. 4 & 5, app. 1).

Topographically, the southern 'Araba Valley is almost flat, with steep mountains on both sides. The climate in the region is hyper-arid. Summer temperatures often rise above 40°C, annual average precipitation is below 30mm and the potential evaporation reaches around 4000mm per year (Goldreich 2003: 118–22). Palaeoenvironmental and palaeohydrologic records indicate various fluctuations during the mid Holocene, though the climate was still hyper-arid (Avner 2002: ch. 7; Frumkin & Elitzur 2002; Migowski *et al.* 2006). Savannah-like vegetation of *Acacia* trees, accompanied by Saharo-Arabian semi shrubs, is the main vegetation feature of large parts of the 'Araba Valley. In the southern 'Araba, the Yotvata acacia savannah is conspicuous in its high tree density, due to local high water tables (Danin 1995). The three Samar kites are built to the south of this area, all opening towards the savannah. The Evrona basin (c. 15km south of Samar) also has a high water table and accordingly a high density of acacia trees. Animal trails leading to each of these two vegetation-rich settings are still in use. These conditions supported several species of herbivores, predominantly gazelle, as well as Arabian oryx, onager and ostrich (*Struthio camelus*) (Mendelssohn & Yom-Tov 1999; Dolev & Perevolotsky 2004).

The archaeological data and post-kite structures strongly suggest that the kites were contemporaneous and could have been used simultaneously. In this respect these kites are somewhat similar to the chain kites in the Black Desert of eastern Jordan (e.g. Jawa and Dhuweila areas), though on a much smaller scale. The three kites were built using the same construction plan and building methods. This involved: a) digging a pit into a shallow wadi bed, taking advantage of even the smallest available topographic feature; b) constructing the enclosure walls and arms from local stones and boulders; and c) building a ramp at the apex of the kite to enhance a vertical drop (in the two western ones) and to hide the enclosure from the driven game. This is the first documented example of such intricate planning of a kite, incorporating natural features as well as digging and construction.

The environmental setting of the Samar kites is clearly related to the rich pasture area of the Yotvata savannah, an area that attracted a variety of herbivores all year round. The arms of the kites were erected along (or at slight angles to) the existing animal trails. Once driven and frightened between the walls, the herd gained speed with no opportunity to escape. The constructed ramp at the apex of the enclosure (SWA, SWB) prevented the fast-moving animals from seeing the trap until it was too late to stop. The ramp, the vertical walls and the depth of the pit provided the desired vertical drop and insured that the focal point of the trap functioned in the best possible way. Such a construction would have suited the capture of gazelles, delicate animals that could have broken their legs when falling into the trap, and/or could have been killed by hunters hiding around the enclosure.

The strategy of 'leaving the trails open' between hunting episodes is observed at all 11 Negev and 'Araba kites (regardless of topographic setting). In each, animal trails cross the arms of kites at points where narrow gaps were left within the walls (mirroring the width of the trail). Before the communal hunts, these narrow gaps could have been temporarily blocked by dry bushes or rocks, or manned by hunters.

Conclusion

The well-preserved kites of Samar provide compelling evidence for the use of sophisticated game traps during the fifth to third millennia BC (see also discussion of OSL dates in Porat *et al.* 2009). The chronological framework is based on radiocarbon dates as well as retrieved artefacts. Our new results clearly demonstrate that at least three kites were constructed during or before the Early Bronze Age. It is noteworthy that within the Samar kites, the heads of all three are disturbed by later construction dated to the third millennium BC.

Though sophisticated means of adaptation are known throughout the evolution of hunting, one can certainly admire the achievement of these constructions. They reflect profound knowledge of the hyper-arid environment, the behaviour of the local territorial gazelles and their exact trails, and the local macro- and micro-topography, leading to the choice of the best location for constructing the kite in general, and the enclosure in particular.

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