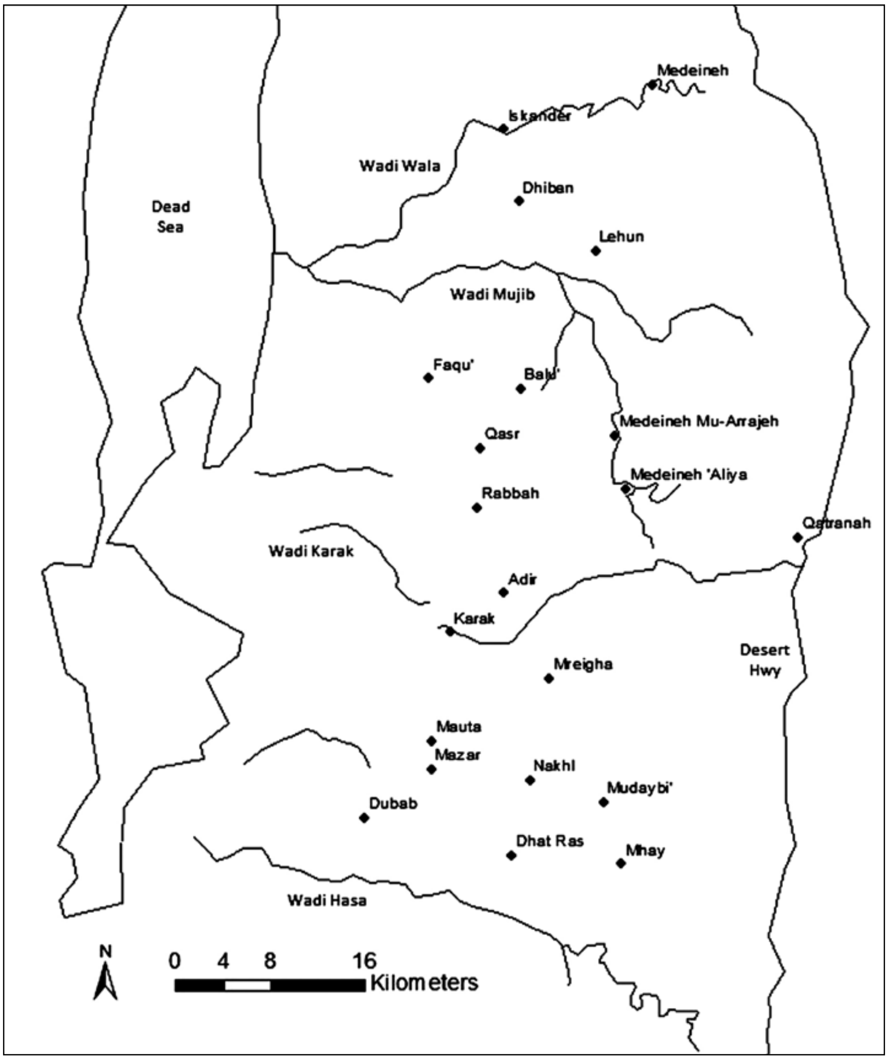
PATTERNS OF SETTLEMENT, ABANDONMENT AND RE-USE DURING THE BRONZE AND IRON AGES IN CENTRAL JORDAN: AN ANALYSIS OF THE OCCUPATIONAL HISTORIES OF INDIVIDUAL SITES USING 'MEGA-JORDAN'

Mark D. Green

Introduction

This investigation focuses on the area comprising Wadi Wala and Wadi ath-Thamad to the north and Wadi Hasa to the south. The region extends eastward from the Dead Sea across the central Jordanian plateau to approximately 15 km east of the Desert Highway at the fringe of the Syrian - Arabian Desert (**Fig. 1**). Though the political boundaries were fluid during the Iron Age, with control of the region - north of the Wadi Mujib - frequently shifting between several competing groups, the study area rep-



1. Map of study area.

resents what is generally recognized as having been Moab during a part of this period (Dearman 1997; Lipiński 2006). Its strategic location in the southern Levant, combined with the surrounding fertile plateau highlands, attracted travelers from throughout the Middle East. The region was important during the Bronze and Iron Ages too, and this has been the subject of many investigations (e.g. Adams 2008; Finkelstein 1995; Kotter 2009; Levy, Daviau, Younker and Shaer 2007).

The landscape of this region gives evidence of the cultural changes that took place during the Bronze and Iron Ages throughout Palestine, for example, walled settlements, water management systems, agricultural 'hinterlands' supporting villages and towns, and trade (Graham 2008: 209). While several projects have completed surface surveys in the area (Mattingly 1997; Miller and Pinkerton 1991; Parker and Betlyon 2006) excavations have focused on a few large walled sites. As a consequence, our understanding of the organization and pattern of settlement, especially smaller settlements, remains incomplete (Graham 2008). We have learned that site location and density were influenced by both environmental and political factors (c.f. MacDonald 2002; Palumbo 2008). With regard to the physical environment, we know that during some periods (e.g. Roman and Umayyad) site locations in the study area were specially selected on the basis of, for example, access to rock outcrops and arable soils (Green 2002). We also know that during the Iron Age the Assyrians prohibited building settlements on high mounds (Fales 1990). It also appears that climate influenced site location, e.g. settlements expanded into what is today the eastern desert during periods of increased rainfall and were then abandoned during periods of aridity (Green 2004).

The Early Bronze Age (EBA) was a period of both significant settlement growth and decline (Chesson, Makarewicz, Kuijt and Whiting 2005). It was only during the Nabataean, Roman and Early Byzantine periods that the number of sites exceeded those of the EBA (Green 2004: table 1). At its peak, the number of EBA sites exceeded the number of Middle Bronze Age (MBA) and Late Bronze Age (LBA) sites by factors of three and five respectively (cf. Dever 2000). Many of the innovations that were first introduced in the Chalcolithic, such as irrigation (Rosen 1995), cultivation (Grigson 1995), olive and vine crops (Genz 2003), donkeys as a pack animals (Ovadia 1992) and an increase in the use of metal tools (Rosen 1997), continued and expanded into the Bronze Age. Though urbanization is generally recognized as having begun in EB I, in the study area many sites were not urbanized until EB II and EB III, a pattern that included the construction of walls around many sites (Sebag 2005). It is in EB II and EB III that the first signs of social stratification are documented (Esse 1989; Finkelstein 1995; Miroschedji 1999). However, "the Madaba region and the Karak Plateau appear to have remained outside this process" (Graham 2008: 210).

The collapse of society throughout the Aegean and the Levant at the end of the EBA has been widely discussed (Cordova 2007a; Homes-Fredericq 2009; Miroschedji 2009; Robbins 2001). The data from central Jordan are mixed. Miroschedji (2009) suggests that the collapse was not as extensive east of the Jordan valley as in other areas. Settlement disappeared between the EBA and Iron Age (IA) at Dhiban (Ji 2007; Porter *et al.* 2007), abandonment of al-Lahun occurred at the beginning of EB IV (Swinnen 2009) and during EB IV at Tall al-'Umayri (Herr and Clark 2007), In contrast, Richard and Long (2007) report a flourishing EB IV settlement at Khirbat Iskander (see also Palumbo 2008) and pottery from both the MBA and LBA has been recovered at Tall Jalul (Younker 2007). MacDonald (2007) reports that the MBA and LBA are poorly represented south of the Wadi Hasa.

In terms of absolute numbers of sites in the study area, the whole of Jordan and much of the Levant (as represented by MEGA-Jordan and the Digital Archaeological Atlas of the Holy Land data) indicate that the number of sites actually increased from EB III to EB IV. That said, the reader is cautioned to avoid drawing conclusions based on counts alone. In many cases the survey data underlying the MEGA-Jordan (and JADIS) datasets lack the chronological precision required to make a definitive comparison (e.g. the majority of surveys combine EB II and EB III sites into a single EB II - III chronological period). Palumbo (2008) suggests that it was a decrease in the size of sites from EB III to EB IV that has led some scholars to conclude that the EB IV was a period of abandonment.

Rather than a wholescale collapse, it seems more likely that the EB IV was a culmination of a decline in EB II - III urban societies and a return to a rural systems referred to as a "rural interlude" by Palumbo (2008: 227) and a "dark age" by Richard and Long (2007: 269).

Urban settlement was reestablished in the MBA (cf. Dever 2003), followed by a decline in sedentary occupation during the LBA (Younker 2007) as localized polities were beginning to emerge (Falconer 2008).

The early IA (12^{th} - 10^{th} centuries BC) was a period of recovery throughout the Levant (Porter 2009). Some sites continued to enjoy prosperity during the LBA, e.g. Tall al-'Umayri (Herr 2000), while others entered into a new period of prosperity, e.g. Tall al-Lahun (Homes-Fredericq 2009) and importance, e.g. Karak (Finkelstein and Lipschits 2011). Early IA settlement was based on "geography rather than political boundaries or defensive needs" (Lev-Tov, Porter and Routledge 2011: 78). Although there is evidence of cooperation and communication between the region's settlers, no early IA administrative center or hierarchy, as observed in other Near Eastern polities, has been identified (Porter 2009). By late IA I, signs of a pre-Moab territorial entity, organized around tribal groups with no identifiable unified monarchy, appeared in the landscape south of the Mujib (Bienkowski 1992; Finkelstein and Lipschits 2011).

Iron Age II settlement was organized around tribal groups that gradually merged into "formal national states with their own monarchies and governmental bureaucracies" (Herr and Najjar 2008: 311). The secondary states of Ammon, Moab, Edom and Israel ascended (LaBianca and Younker 1995), the Assyrians returned to power and the influence of the Egyptians waned. The discovery of four IA II volute capitals at Mudaybi' (Drinkard 1997), IA II steles at Balu' and Shihan (Lipiński 2006), an IA II basalt sculpture and volute capital at Karak (Dearman 1997; Finkelstein and Lipschits 2011) and the Mesha Inscription (Dearman 1989) point to a political structure that evolved into the kingdom / state / nation of Moab (Finkelstein 1995; Herr 2000; Lipiński 2006). Daviau and Chadwick (2007) suggest that while Moab may have been a tribal state, it is impossible to identify distinct tribal cultural indicators given the limited number of excavations and published results. The region to the south of Mujib was apparently undisputed Moabite territory, while control of the area north of Mujib (as far north as Madaba) shifted between Moab, Ammon and Israel (Harrison *et al.* 2007; LaBianca and Younker 1995). Jalul appears to have been located along the southernmost boundary of Ammonite territory (Younker 2007). Although Assyrian troops entered the territory of Moab around 650 BC in pursuit of northern Arabs (Lipiński 2006), there is no record of confrontations between the Assyrians and the Moabites (Bienkowski 2000; Dornemann 1983).

Written sources are silent on Transjordan during the Persian Period. Attempts to reconstruct settlement histories from survey reports are tentative owing to uncertainty over the identification of Persian period material culture in Transjordan (Bienkowski 2008). In spite of this uncertainty, there is evidence from pottery for settlement continuity from the IA II through to the Persian period (Bienkowski 2001, 2002a, 2002b; Bienkowski *et al.* 2002; Herr 1997). Though there is no evidence for the continued status of Moab as a 'state' within the Persian Empire, it is likely that local tribal authorities continued to represent Persian interests (Bienkowski 2008).

The Physical Environment

The study area is located in the 'plateau and mountain zone' of west-central Jordan (Hadidi 1982). It is an uplifted, gently rolling eastwardly sloped peneplain, dissected by deep canyons that trend east to west (Green 2002). Beginning in the Cretaceous period (136 - 65 mya) and continuing through the Oligocene (38 - 26 mya), central Jordan was inundated by the ancient Tethys Sea. Several episodes of oceanic transgression and recession deposited most of the sedimentary bedrock in the region. During the Miocene (26 - 7 mya) and Pliocene (7 - 1.8 mya) as the Tethys Sea receded for the last time, compressive and tensional forces along the boundary between the Sinai microplate and Arabian plate formed the Great Rift Valley that extends nearly 6,000 km from Turkey to East Africa (Atallah 1991; Garfunkel *et al*. 1981; Husein *et al*. 1995; Mechie and el-Isa 1988; Salameh 1997; Sneh 1996; Wdowinski and Zilbermann 1996). The Rift Valley between the Sea of Galilee and the Dead Sea is known as the Ghor (Ar. *al-Ghawr*). Forces along the plate boundary resulted in a lateral displacement (strike-slip) of approximately 107 km in the Jordan valley (Atallah 1991; cf. Guiraud and Bosworth 1999). Local rifting and rotation along this boundary created the Dead Sea basin, the uptilted and uplifted plateau highlands, and erupted most of the highland basalt flows found on the plateau highlands and in the *wadi* canyons (Bayer *et al*. 1988; Brown, Schmidt and Huffman 1963; Burdon and Quennell 1959; Donahue 1985; Homes-Fredericq 1997; Mansoor 1999; Mechie and el-Isa 1988). Faults and fractures are found throughout the region. One of the region's more spectacular faults is the Fajj al-'Usaykir, which is part of the 300 km Karak - Wādī el-Fiha fault zone that extends from Karak to Saudi Arabia. The region continues to be tectonically active (el-Isa 1984; el-Isa and Shanti 1989; Jussim and Green 1999; Karcz *et al*.1977; Macumber *et al*. 1997).

The region's drainage network formed early in the tectonically active phase along faults and fractures that functioned as conduits for surface and groundwater flow (Ginat *et al*. 1998; cf. Gupta and Jindal 2000; Horowitz 1987; Khalil 1992; Powell 1988; Salameh 1997; Tarawneh 1991). Repeated cycles of intense storms and high magnitude flash floods cut the deep canyons of the region's three largest *wadi*s (Mujib, Hasa and Karak) that flow into the Dead Sea (Odeh and Salameh 1988; Salameh 1997). The combined basin drained by the wadis is 9,306 km^2 (MacDonad and Partners 1973; Salameh 1997). The level of the Dead Sea and its predecessors (Lake Samra in the Lower Pleistocene and Lake Lisan *ca* 50 - 12,000 BP) fluctuated many times during this period, resulting in significant erosion of the limestone and sandstone at the mouths of the major *wadi*s where they emptied into the Dead Sea basin. These events have been recorded in more than 30 shore terraces that are preserved along the base of the Dead Sea escarpment and relict deltas where the major *wadi*s drain into the Dead Sea basin.

Precipitation and temperature have varied throughout antiquity (cf. Bar-Matthews *et al*. 1998; Brayshaw *et al*. 2011; Courty and Vallverdu, 2001; Robinson *et al*. 2011; Wilkinson 2003), where an increase in one is correlated with a decrease in the other (al-Eisawi 1985). The current semi-arid environment often misleads one into assuming that the region has always been hot and dry. During the Chalcolithic and intermittently through the EBA the region was wetter than today. Analyses of remnant shore lines along the Dead Sea (Frumkin and Elitzur 2001) and the Sea of Galilee (Hazan *et al*. 2005), pollen (Neumann *et al*. 2007), organic matter in fossil land snails (Goodfriend 1990), and speleothems (Bar-Matthews and Ayalon 2004) indicate that the climate was considerably less stable than today with alternating high amplitude oscillations from wet to dry and vice versa (also cf. Schaub and Chesson 2007). Conditions became very arid during EB III (Bar-Matthews *et al*. 1998; Harlan 1985; Nissenbaum 1994; Rosen 1998). Aridity persisted throughout the remainder of the EBA, MBA, LBA and IA, before coming to an end in the Persian period (Donahue *et al*. 1997; Harlan 1988; Issar and Brown 1998; McGovern 1987; Netser 1998; Nissenbaum 1994; Raikes 1985; A. M. Rosen 1998; Shehadeh 1984; Wilkinson 2003).

Precipitation generally decreases as one goes from north to south and from east to west across the Levant, although there are micro-regions of high aridity and high rainfall punctuating this trend. Within the study area, the dramatic change in topography as one moves west to east up the Dead Sea escarpment, across the Transjordan plateau and into the Syrian - Arabian Desert, creates an environment where precipitation and temperatures change rapidly over a relatively short distance (Zohary 1973). Average annual precipitation is currently 325 - 350 mm on the plateau highlands, between 80 and 180 mm on the eastern plateau and less than 80 mm in the desert regions (Cordova 2007b; Foss 2003). Actual amounts vary considerably from year to year with periods of drought being common. Average annual temperatures are between 15 and 20 degrees Celsius and can approach 40 degrees when the hot summer *khamasin* winds blow from the east (Foss 2003; MacDonald 2002). These conditions create four geobotanical regions within the 4,500 km^2 study area: (1) the plateau highlands Mediterranean region, (2) the semi-desert Irano-Turanian steppe region that encompasses a 15 km-wide zone extending west from the Desert Highway, (3) the Sudanian region in the Dead Sea Ghor and (4) a narrow Saharo - Arabian desert region that extends east of the Desert Highway (cf. al-Eisawi 1985; cf. Cordova 2007b; Zohary 1973).

The region's complex climate, vegetation, topography and geology have produced a wide variety of soils (cf. Jenny 1941). Wind borne loess is the predominant soil on the plateau with alluvial soils common in the *wadi*s (Burdon and Quennell 1959; Foss 2003). The deep soils of the plateau highlands are dominated by red *terra rossa* Mediterranean soils with shallow grey - brown soils in the eastern semi-desert region (Zohary 1973). The highlands are very fertile and provide an excellent environment for the production of cereal crops, pasturing and growing fruit trees (Homes-Fredericq 2000; LaBianca and Younker 2003). The irrigated soils of the Ghor are some of the country's most agriculturally productive (Dunbar 2008). Soil erosion is a serious problem throughout the region where slopes exceed 3-5% (Foss 2003).

Access to water was and continues to be a critical consideration in the location of settlements within the study area. Through natural and manmade structures, adequate water can be captured and stored to support year-round settlement across much of the region, even during the driest periods. Cisterns are common, particularly on the plateau highlands. Highland sites frequently exploited natural features or modified them to capture and store precipitation from winter storms in caves and man-made cisterns. Many old cisterns have been modified (e.g. with the addition of concrete capping blocks with metal doors) and are still in use today. Several types of water collection and storage structures are found in the study area: *biyar mujammi* (collecting wells) in the Karak region, *biyar hayy* (living wells) filled from underground sources, *mushash* (pits dug in clay soils), *qalib* / *zalib* (deep hand-dug wells), *mahfur*s dug by *bedouin* to collect water from enclosed depressions or at the junction of two *wadi*s, and *thumaila* - also constructed by *bedouin* - which are shallow pits dug down to rock that collect water from underground seeps (Lancaster and Lancaster 1999). The author observed several *thumaila* filled with fresh water (one was home to several frogs) in the semi-arid Fajj al-'Usaykir in July 2011 (**Fig. 2**). Springs (Ar. *al-'Ayun*) are also common in some parts of the study area. They are found along the slopes of the major *wadi*s and Dead

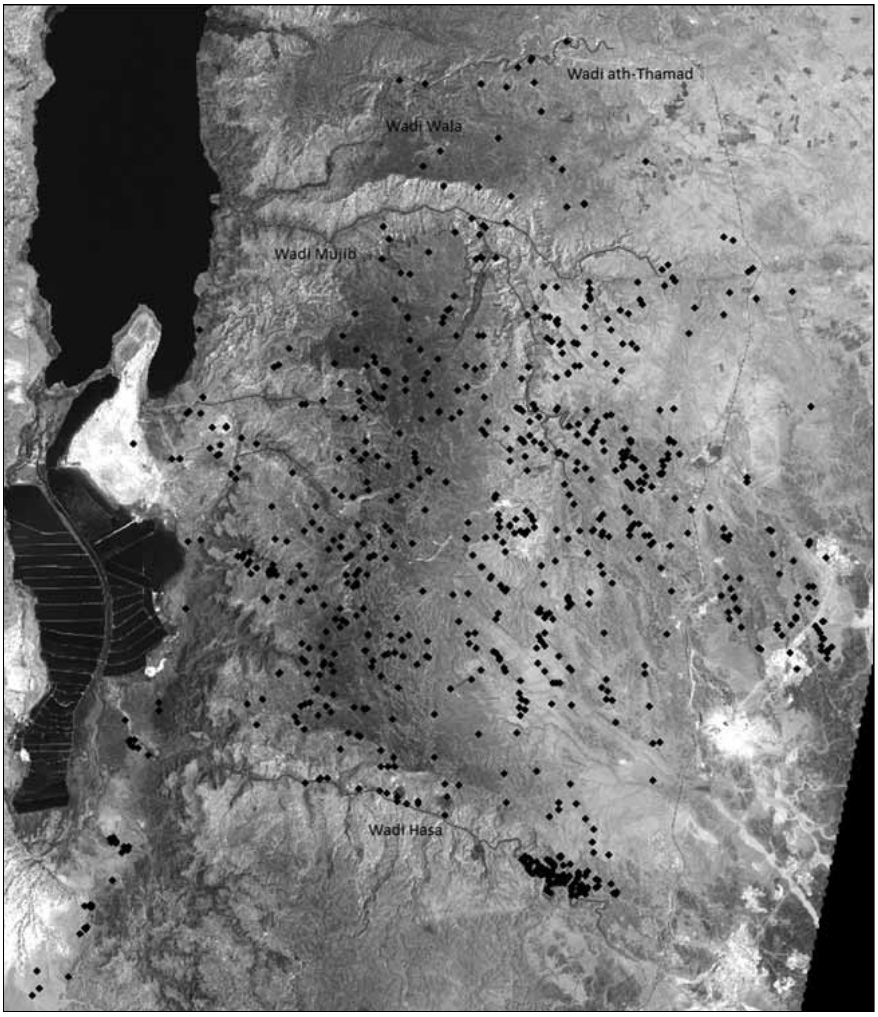
2. *Thumaila in Fajj al-'Usaykir (July 2011).*

Sea escarpment, and are especially plentiful and large in Wadi Hasa. In 1960 it was estimated that all of the Wadi Hasa's springs together were producing 150,000 gallons per minute. (`Ain 1960: 20).

Methodology

Several investigations have looked at regional settlement patterns during the Bronze and Iron Ages (cf. Boling 1988; Dearman 1992; Graham 2008; Green 2004; Sauer 1986). This investigation looks at Bronze and Iron Age settlement at the level of individual sites: (1) general physical setting, (2) when a site was first settled, (3) if and when it was abandoned and (4) if it was re-used after abandonment. Through documenting changes at the level of individual sites we gain a much better understanding of settlement shift at the regional scale.

The MEGA-Jordan database was the primary source for site data in this analysis. The MEGA-Jordan project was launched as a collaboration between The World Monuments Fund, the Department of Antiquities of Jordan and the Getty Conservation Institute for the development and implementation of a GIS to inventory and manage Jordan's numerous archaeological sites. The MEGA-Jordan database includes site data imported from the Jordan Antiquities Data Information System (JADIS), originally created by Gaetano Palumbo (1994), and recent survey reports. At the time of writing, the database contained 10,955 sites with 45,570 site elements. Additional site data from the survey of the Karak Resources Project was added to the project dataset. More recent data from other sources was also included in the analysis (e.g. re-examination of site data [Brown 2010]). The full dataset for the study area includes 822 sites that were occupied at some point during the Bronze



3. Site locations (base image produced using Landsat 7 ETM+ satellite data acquired from the US Geological Survey, EROS Data Center, Sioux Falls, SD, USA; copyright 1995-2004 Environmental Systems Research Institute Inc. (ESRI) with permission).

and Iron Ages (**Fig. 3**). The dataset used in this analysis includes everything from sherd scatters to fortified structures with walls. The reader should be aware of the limitations of statistics arising from survey data, for example, uneven distribution of survey information (e.g. Chalcolithic sites derived from Jordan Valley surveys [Bourke 2008]) and the identification of survey material at a macro level owing to a lack of good local chronologies, or having detailed chronologies for only one period (e.g. the Early Bronze Age focus of Chesson *et al*. 2005). Another consideration is the inconsistent dating of pottery (Finkelstein and Lipschits 2011; cf. Savage *et al*. 2007; cf. Strange 2008).

Most surveys do not report chronological subdivisions for the Bronze Age (e.g. EB I, II, III and IV). Only 29% of the EBA sites, 18% of the MBA sites and 12% of the LBA sites are dated to a specific chronological subdivision (**Fig. 4**). As a consequence the Early, Middle and Late Bronze Ages were not analyzed here at the level of chronological subdivisions. Unfortunately, looking at the EBA, MBA and LBA as single periods fails to capture the cycles of expansion and abandonment within each period (cf. Gophna 2003). The chronological precision of the site data for the IA was much better (93% of the sites were dated to the precision of the subdivisions I, IIab, IIc or III). Because 95% of the IA II sites were settled during both the IA IIa/b and IA IIc, IA II period sites (a/b, c and unspecified) were analyzed as a single IA II period rather than by the IA II chronological subdivisions. Thirty-four sites in the IA II category were originally reported as 'Iron unspecified' in the published reports of the Karak Resources Project (KRP). At the suggestion of Dr Jerry Mattingly, director of the KRP, these sites were included as IA II for this investigation.

Six broad geomorphic zones can be documented in the study area (highlands, the Ghor, the escarpment, *wadi*s, desert and semi-desert). For the purpose of this investigation, these were combined into four larger zones on the basis of soil characteristics. These are: (1) the plateau region (including the plateau highlands and the Ghor), (2) the desert region (a zone extending east from the Desert Highway), (3) the semi-desert region (a zone extending 15 km west from the Desert Highway) and (4) *wadi*s (including the major Wadis Mujib, Hasa and Karak, and the Dead Sea escarpment). Sites are located in each of the four zones, .approximately 8% in the desert region, 24% in the semi-desert region, 26% in the *wadi*s and 42% in the plateau zone. The plateau highlands were continuously settled througout all periods and there was considerable variation in the settlement of the other zones.

Analysis

There were commonalities in the site data across all periods. The clustering of sites was statistically significant in all periods (statistically significant at a 99% confidence level calculated using ArcGIS Multi-Distance Spatial Cluster Analysis / Riply's K-function and Average Nearest Neighbor). A minimum of 40% of sites in each period were established in new, previously unused locations (**Fig. 5**), and although the rate of site abandonment was extremely high during the EBA and IA II, site abandonment generally was common throughout the Bronze and Iron Ages. With the exception of the EBA and IA II, new site locations were abandoned at a higher rate than sites in reused locations.

Early Bronze Age

The number of sites in the desert and semi-desert zones was significantly higher during the EBA than any other period (55% of all EBA sites compared to 1% in the MBA, 2% in the LBA, 5% in the IA I and 4% in the IA II) (**Fig. 6**). In spite of a perceived preference for locating sites in the arid region, there was an avoidance of the desert and semi-desert region for locating new sites. Out of 196 EBA sites settled in new locations, only 3% were located in the eastern desert. A similar pattern was documented in the semi-desert region where 23% of newly located

	Early Bronze		Middle Bronze		Late Bronze		Iron I		Iron II	
	No.	%	No.	%	No.	%	No.	%	No.	%
Unspecified	328	71%	66	83%	123	88%	44	7%	52	15%
Subdivided	136	29%	14	18%	17	12%	605	93%	300	85%
Total	464		80		140		649		352	

4. Distribution of sites by chronological period.

				Abandoned in Period Immediately Following			Abandoned Through Persian Period		
Period	Total No. Sites	New Site Locations	Reused Locations	New Site Locations	Reused Site Locations	All Site Locations	New Site Locations	Reused Site Locations	All Site Locations
Chalcolithic	283	-	-	-	-	15 5%	-	-	-
Early Bronze	464	196 42%	268 58%	166 85%	253 94%	419 90%	79 40%	178 66%	257 55%
Middle Bronze	80	32 40%	48 60%	17 53%	10 21%	27 34%	8 25%	5 10%	13 16%
Late Bronze	140	56 40%	84 60%	36 64%	37 44%	73 52%	16 29%	19 23%	35 25%
Iron I	167	67 40%	100 60%	36 54%	21 21%	57 34%	32 48%	16 16%	48 29%
Iron II	352	192 55%	160 45%	135 70%	121 76%	256 73%	135 70%	121 76%	256 73%

5. *Distribution of sites by location type: new and re-used.*

	Geomorphic Setting								
	Desert #	Desert %	Semi-Desert #	Semi-Desert %	Wadi #	Wadi %	Plateau #	Plateau %	Total Sites
Early Bronze - New	6	3%	46	23%	58	30%	86	44%	196
Early Bronze - Reused	69	26%	135	50%	24	9%	40	15%	268
Early Bronze - All	75	16%	181	39%	82	18%	126	27%	464
Middle Bronze - New	-		-		17	53%	15	47%	32
Middle Bronze - Reused	-		1	2%	17	35%	30	63%	48
Middle Bronze - All	-		1	1%	34	43%	45	56%	80
Late Bronze - New	-		1	2%	9	16%	46	82%	56
Late Bronze - Reused	-		-		19	23%	64	77%	84
Late Bronze - All	-		2	1%	28	20%	110	79%	140
Iron I - New	-		6	9%	37	55%	24	36%	67
Iron I - Reused	2	2%	1	1%	30	30%	67	67%	100
Iron I - All	2	1%	7	4%	67	40%	91	55%	167
Iron II - New	-		2	1%	152	79%	38	20%	192
Iron II - Reused	2	1%	10	6%	50	31%	98	62%	160
Iron II - All	2	1%	12	3%	202	57%	136	39%	352

6. *Distribution of sites by geomorphic setting.*

sites were in that zone. 90% of EBA sites were abandoned by the MBA, with 55% of those sites remaining abandoned into the Persian period. All sites located in the eastern desert, semi-desert and Wadi Mujib were abandoned by the end of the EBA. With the exception of two sites in the Ghor, *viz.* one in Wadi Hasa and one in Wadi Wala, the only sites not abandoned during the EBA were those located on the plateau highlands.

Middle Bronze Age

Settlement in the eastern desert during the MBA was exceptionally low and only 1% of MBA sites were located in the semi-desert zone generally. In contrast, 56% of all MBA sites were located on the plateau highlands with the remaining 43% located in Wadis Mujib and Hasa, and along the Dead Sea escarpment. A small (4.5 km^2) cluster of seven sites was located in a region near the head of Wadi Hasa, but all were abandoned by the end of the MBA. The only MBA sites still occupied in the LBA were those on the plateau highlands and the Dead Sea escarpment.

Late Bronze Age

The percentage of sites in the plateau zone was much higher during the LBA than any other period (79% compared to 27% in EBA, 56% in MBA, 55% in IA I and 39% in IA II). The eastern desert remained sparsely populated, with only 1% of LBA sites located in the semi-desert region. The geographic center of LBA settlement shifted west in comparison to the MBA (measured using ArcGIS Mean Center and Central Feature). While sites in all locations were abandoned during the LBA, a disproportionate share of the abandonments involved plateau highland sites located south of Karak (69%).

Iron Age I

There was a modest return of settlement to the semi-desert and eastern desert during IA I, in addition to settlement of the *wadi*s (primarily Wadi Hasa). Within Wadi Hasa, 85% of IA I sites were located in a 15 km^2 area near to the head of the *wadi* (**Fig. 7**).

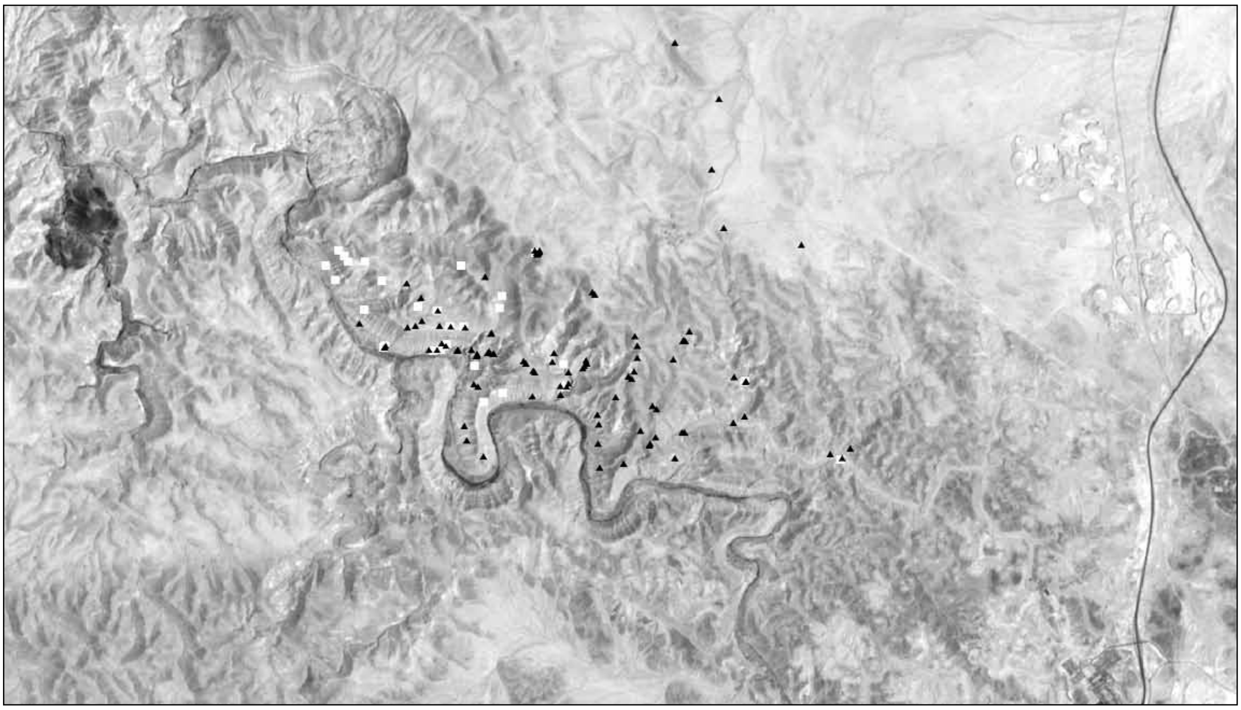
The southern boundary of this study followed that defined by MEGA-Jordan, namely at the bottom of the Wadi Hasa ravine. As a result, only sites on the northern face of the canyon were included in this analysis (a review of the site data for the opposite side found only three IA sites). Most sites in the 15 km^2 cluster were established in new locations. Settlement in the semi-desert and *wadi* zones was predominantly at new site locations (86% and 55% respectively), compared to only 26% of the plateau. At Wadi Hasa, 70% of sites were abandoned by IA I, while on the Dead Sea escarpment it was 54%; in the Ghor it was 67% and in the semi-desert transitional zone it was 71%. In stark contrast, of the fifteen sites settled north of Wadi Mujib, not one was abandoned.

Iron Age II

IA II was a period of significant expansion outside the plateau highlands with the total number of sites more than doubling from IA I. A majority (55%) of sites were in new locations. Of these, 79% were in the *wadi*s and Dead Sea escarpment. North of Wadi Mujib, all of the IA I sites continued to be occupied, in addition to the establishment of two sites in new locations. Like the EBA, IA II was a period of significant abandonment. 73% of all Iron II sites were abandoned by the Persian period. Abandonment was most dramatic in the Ghor, along the Dead Sea escarpment, north of the Mujib and in Wadi Hasa, with 93% of all sites in these locations being abandoned. Of particular note is a cluster of ninety-five sites (27% of all IA II sites) within a 17 km^2 area near the head of Wadi Hasa (**Fig. 7**) that were abandoned at this time.

Discussion

The shifting pattern of settlement during the Bronze and Iron Ages has been the focus of many investigations. While abandonments were common in each period, the very large number of sites abandoned during the EBA has been the focus of particular interest. When we



7. Iron Age sites clustered near the head of Wadi Hasa: Iron I = white squares; Iron II = black triangles.

examine EBA abandonment at the level of individual sites (i.e. the total raw count of abandonments), the pattern suggests that the desert and semi-desert regions were preferred locations in the EBA. However, when we look at the distribution of new and existing sites, very few new site locations were established in the eastern region during the EBA. 92% of the EBA desert sites and 75% of the EBA semi-desert sites were in locations that had been occupied during the Chalcolithic. Proxy data indicate that precipitation was high at the end of the Chalcolithic, but began a stepwise trend toward aridity from the beginning of the EBA that culminated in the arid conditions we have today by the EB III. The distribution of new and re-used site locations suggests that during this trend toward aridity, conditions were adequate to support continued settlement in locations already established, while discouraging the establishment of new sites in the arid eastern desert (cf. Gophna 2003). This trend, along with the continued abandonment of the eastern desert throughout the remainder of the EBA and IA, and only minor resettlement in the semi-desert zone during the Iron I, offers additional evidence for climatic influence on settlement in the region. There was a return to the desert during the Persian period, although climate may not have been the driving force behind this resettlement.

An analysis of the sites clustered near the head of Wadi Hasa during the MBA, IA I and IA II also reveals an interesting trend. The degree to which this area was settled in new locations and the rate at which those sites were abandoned is striking. Though there were only six MBA sites in this location, all six sites were in new locations and all were abandoned by the end of the MBA. Of the 30 IA I sites located in this region, 71% were new settlements. Of the new settlements, 68% were abandoned, and 68% of all sites in the cluster were abandoned. During the IA II, of the 95 sites in the area, 76 (80%) were in new locations and all 95 were abandoned. The abundance of springs in the area undoubtedly contributed to the favorability of the location and may explain the frequent shifting of sites to new locations as settlers sought out productive springs. MacDonald (2002) suggests that springs may have been more numerous and stronger flowing during the IA around Busayra, south of Wadi Hasa. In addition to the role that water may have played, it has also been suggested that Wadi Hasa was settled out of necessity owing to the more favorable highland locations already being "filled up" (Harlan 1988: 47). Though the region south of the Wadi Hasa channel is outside the area of this investigation, a review of site data in that region found that in contrast to the dense settlement on the north side of the Wadi Hasa canyon during the IA, very few sites were located on the south side of the canyon and the adjacent plateau.

Throughout the Bronze and Iron Ages, the different rates of abandonment for new locations versus re-used locations reveal an interesting pattern. During the two periods when site abandonment was the greatest (EBA and IA II), re-used locations were abandoned at a higher rate than new site locations. In contrast, during the MBA, LBA and IA I when the overall rate of abandonment was considerably less, sites in new locations were abandoned at a higher rate than those in existing locations. If the hypothesis proposed in the preceding paragraph is correct, the lower rate of new site abandonment during the EBA can be attributed to the careful selection of locations for those sites (on the plateau highlands) that were better suited to withstand periods of aridity. The lower rate of abandonment of sites in new locations during the IA II seems unrelated to climate and needs further analyis. The higher rate of abandonment of new site locations during the MBA, LBA and IA I may indicate that the more suitable locations for sites were those that had already been settled in earlier periods. Additional analysis of the physical environment associated with each of the abandoned locations is recommended to determine if the micro-climate (e.g. prevailing winds) and access to essential resources (e.g. water) were unfavorable and / or limited, and inadequate to sustain settlement in those locations.

A final observation is the increase in settlement north of Wadi Mujib during the IA, primarily through the establishment of sites in new locations. Though the area had been settled prior to the IA (five sites in the EBA, one site in the MBA and one site in the LBA), the increase in the number of sites (15 in the IA I and 17 in the IA II), with the majority of those sites in new locations (65%), suggests a rise in the importance of the area during the IA (cf. Routledge 2004). This corresponds well with events in the region as described in the text of the Mesha inscription (see Dearman 1989), the Kurkh monolith (see Sayce 1889) and 2 Kings 3 in the Hebrew Bible.

Conclusion

Settlement patterns observed through the occupational histories of individual sites have revealed details not visible at a regional scale. At the regional scale, it can appear as if all types of sites were part of major shifts in settlement (e.g. a move out of the desert, or converging into a small area near the head of Wadi Hasa). However, when individual sites are observed, it is clear that the uniformity observed at a macro level disappears at the micro level with changes in settlement location being different for sites established in new locations, compared to sites established in re-used locations. Where settlement shift on the plateau highlands typically involved sites from both new and re-used locations, shifts in settlement outside the highlands (e.g. occupation of the region north of Wadi Mujib and the abandonment of the eastern desert), almost always involved an overwhelming majority of sites from either those occupying new locations or those occupying re-used locations, not both.

This investigation considered the physical environment associated with site locations. The data suggested that decisions about where to settle during some periods were associated with changes in the physical environment (e.g. no new settlement in the eastern desert during the EBA), while in other periods decisions appeared unrelated to the physical environment (e.g. settlement of the region north of Wadi Mujib during the Iron Age). Additional work at the level of individual sites is needed to explore other factors (e.g. geopolitics and microenvironments) that may have influenced the decision to settle new locations as well as abandon existing locations.

Mark D. Green
Indiana State University
Department of Earth and Environmental Systems
Terre Haute, IN 47809
USA

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