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Authors
Knabb, Kyle A
Najjar, Mohammad
Levy, Thomas E

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Characterizing the rural landscape during the Iron Age and Roman period (ca. 1200 B.C.–A.D. 400): An intensive survey of Wadi al-Feidh, southern Jordan

Kyle A. Knabb, Mohammad Najjar, Thomas E. Levy

University of California, San Diego

Archaeological surveys in the southern Levant have traditionally focused on areas with favorable climates and flat terrain where large urban sites are found, corresponding with a research focus on social complexity and state formation. Fewer surveys have explored the rocky, difficult-to-reach areas where large-scale agriculture was rare. This article uses survey data from the 2009 survey of Wadi al-Feidh, southern Jordan, to demonstrate the importance of exploring these environmentally marginal areas. Employing an intensive survey methodology, we recorded a range of sites and features previously unrecognized in this region. These findings suggest that subsistence patterns shifted from small-scale, mixed agro-pastoralism in the Iron Age (1200–586 B.C.) to a more intensive, top-down strategy of agricultural production by the Roman period (ca. 100 B.C.–A.D. 400). The results provide new insight into regional socioeconomic change in the southern Levant from the perspective of peripheral communities.

Keywords: systematic survey, agro-pastoralism, agricultural intensification, marginal environment, Levant

Introduction

The use of systematic, regional survey has been a mainstay of archaeological research on settlement patterns and the development of complex societies in many areas of the world. Surveys in Mesoamerica (Balkansky 2006; Balkansky *et al.* 2000; Feinman *et al.* 1985; Ford and Fedick 1992; Healy *et al.* 2007; Killion *et al.* 1989), South America (Drennan *et al.* 1991; McAndrews *et al.* 1997; Wilson 2009), the northern Mediterranean (Ammerman *et al.* 2013; Bevan and Conolly 2002; Bintliff 1997; Given *et al.* 1999), the Near East (Ur and Hammer 2009; Wilkinson 2000; Wilkinson *et al.* 2007), and east Asia (Drennan 2010; Linduff *et al.* 2002; Underhill *et al.* 1998) have made significant contributions to our understanding of changing patterns of settlement and land use, particularly with relation to changing political, socioeconomic, and environmental conditions. These projects have also been successful in delineating the relationships between urban centers and their hinterlands, and recent research has continued to expand our understanding of peripheral areas through the study of non-sedentary pastoralism (Frachetti and Mar'yashev 2007; Rosen 1987a; Ur and Hammer 2009), local adaptation to ecological niches (Bevan and Conolly 2009; Ford and Fedick 1992), small-scale metallurgical production (Ben-Yosef *et al.* 2010; Georgakopoulou 2014), and movement across landscapes (Gibson 2007; Snead *et al.* 2006). Remote areas, often with relatively difficult terrain, are increasingly being targeted as a result of this new research. A systematic approach is less common in these cases due to the difficulties and costs associated with employing such a rigorous methodology. In the southern Levant this is especially so, and the Wadi al-Feidh survey presented here attempts to address this issue.

Many surveys carried out in the southern Levant were influenced by the work of Adams and others in Mesopotamia (Adams 1965, 1981; Wilkinson 2003). These surveys covered large areas using extensive pedestrian or vehicular methods, and while not ubiquitously, often employed systematic, full-coverage methods. With few exceptions (e.g., Haiman 1989; Rosen 1987b), most surveys targeted flat areas that are easily traversable and have favorable climate conditions. The result of this extensive survey methodology has, in many cases, been biased towards large and highly visible sites such as tells and other large agricultural settlements.

Archaeological research in southern Jordan is a case-in-point in which survey projects have targeted the well-watered Jordanian plateau or the lowlands

Correspondence to: Kyle A. Knabb, Anthropology Department, University of California, San Diego, 9500 Gilman Drive #0532, La Jolla, CA 92093-0532. Email: kknabb@ucsd.edu

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of the Arabah Valley (Banning 1996). Extensive survey methodologies are ill-suited for many parts of modern day Jordan and Israel, where sites tend to be smaller in size, and the terrain is less conducive for visually locating sites using more extensive survey techniques (i.e., >50–100 m spacing between surveyors or "windshield surveys"). In a similar vein, though many projects have adopted an approach that acknowledges the important role of hinterlands, fewer have attempted to study the issue directly. Some notable examples from the southern Levant include el-Khouri's study (2008) of the Roman countryside of northwest Jordan, Fall and colleagues' research (1998) on Bronze Age rural economies in the Jordan Rift Valley, and Barker's study (2012) of nomad-farmer interactions in southern Jordan.

In recent years, more research has begun to focus on the role of peripheral societies and pastoral and agropastoral communities in regional-scale socioeconomic processes (Barker 2012; Frachetti 2012; Honeychurch 2013; Hritz 2013; Knapp 2003; Levy 2009; Porter 2012; Porter 2013; Rosen 1987a; Ur and Hammer 2009). Archaeologically, the diverse historical and social evolutionary trajectories of these groups are sometimes visible in regional surveys and excavations, but more often their presence is inferred from historical sources. With recent studies targeting these societies directly, we now have a better understanding of their basic social organization and varied responses to climate change and processes of environmental degradation (Chepstow-Lusty 2011; Crumley 1994; Hill 2004; Høgestøl and Prøsch-Danielsen 2006), as well as the degree of variability and complexity of these systems across time and space (Casana 2013; Crumley 1994; Porter 2011). Despite the lack of archaeological studies in Jordan that directly address these issues, Jordan is an excellent place to study the evolution of non-urban communities because of its long history at the periphery of ancient states and empires. Nomads and farmers have resided here throughout history, and although researchers working in the southern Levant have grappled over the nature of the interaction between nomadic and sedentary communities and how to identify shifts between nomadism and sedentism for some time (Banning 1986; Finkelstein 1992; Finkelstein and Perevolotsky 1990; Parker 1987; Rosen 1992), substantial work remains to be done on the nature of the society of those living in marginal zones on the periphery.

This article presents results from the 2009 Wadi al-Feidh Survey (*wadi* = Arabic for valley/river valley) in southern Jordan—a rugged, mountainous zone between the Arabah lowlands and the highland Jordanian plateau (FIG. 1). Previous surveys have not systematically covered this region (e.g., Hart and Falkner 1985; Hübner 2004; MacDonald 1992), in part because of the rough and rocky landscape. Due to this terrain, along with the fact that sites here are smaller and unobtrusive, traditional site-based survey methods are ill-suited for this area. Based on new survey data, we examine settlement patterns from Wadi al-Feidh in relation to existing settlement patterns identified on the Jordanian plateau. Our new results suggest that subsistence patterns shifted from small-scale, mixed agropastoralism in the Iron Age (1200–586 B.C.) to a more intensive, top-down administrative strategy of agricultural production in the Roman period (ca. 100 B.C.–A.D.400). Overall, these new data are inconsistent with Iron Age settlement patterns from the Jordanian Plateau, but they are fairly consistent with Roman period settlement patterns throughout the southern Levant. This discovery implies substantially more heterogeneity of the subsistence economics of Iron Age societies, followed by a relatively homogenous strategy of agricultural expansion and management. In both cases, the results reflect human adaptations to local ecological factors, albeit at different scales. Our approach emphasizes the role of the local landscape and environment in how groups structure and organize their use and occupation of places.

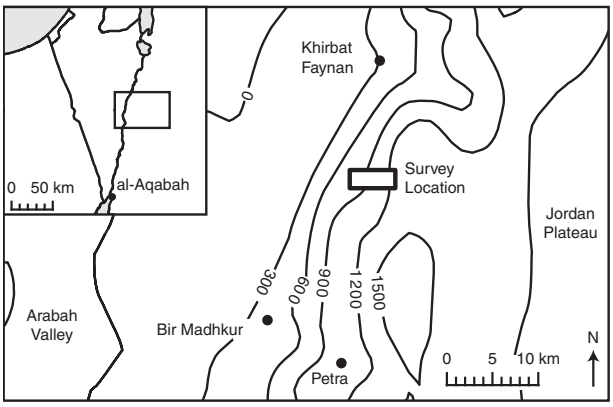

Figure 1 Wadi al-Feidh survey area shown between the Jordanian Plateau and the Arabah Valley. Inset shows location of survey area within the southern Levant.

Regional Background

The ecologically marginal zones of southern Jordan have received little attention compared to well known political centers on the Jordanian plateau. We define ecologically marginal as areas that are characterized by aridity, rough terrain, and little arable land. Until recently, most surveys and excavations in southern Jordan focused on examining the development of the Edomite and Nabataean kingdoms (Bennett and Bienkowski 1995; Bienkowski 2002; Glueck 1939; Joukowsky 1998; MacDonald *et al.* 2004). Based on historical sources, scholars argued that these polities traced their origins from pastoral nomadic societies (Edelman 1995; Graf 1990). No traces of these nomadic origins have been found in Jordan, however, perhaps due to the lack of surveys targeting this kind of ephemeral settlement.

The Iron Age in southern Jordan marks the emergence of the first indigenous kingdom (state-level society) in the region, the Edomites (FIG. 2). The current evidence from southern Jordan suggests that Edomite settlements were composed of agricultural villages founded at the beginning of the 8th century B.C., at least 200 years later than those on the north and central Jordanian plateau (Bienkowski and van der Steen 2001; Herr and Najjar 2001; LaBianca and Younker 1998). This late Iron Age society has been described as a tribal state (LaBianca and Younker 1998; Levy 2009; Porter 2004) that became a settled, agricultural society in the highland plateau region of southern Transjordan by the 8th century B.C.

These models, however, are based on surveys and excavations at major Edomite centers on the plateau, such as Busayra, Tawilan, and Umm al-Biyara (Bienkowski 1990). The early surveys on the Jordanian plateau (Glueck 1935; Hart 1992; MacDonald 1988, 1992) were carried out using extensive, and often unsystematic survey methodologies. Thus settlement pattern data relies on unsystematic surveys and a small number of excavations on the climatically favorable areas of the plateau. While some reconnaissance surveys have identified a network of hilltop sites and small agricultural villages in the mountainous regions of Edom (Hart 1992; Lindner and Farajat 1987; Lindner *et al.* 1997; Lindner *et al.* 1996a; Lindner *et al.* 1998), their relationship to the Edomite kingdom is not well understood.

Following a brief gap in settlement, historical sources describe how the Nabataean kingdom emerged in southern Jordan during the end of the Hellenistic period (ca. 3rd century B.C.) (FIG. 2) (Graf 1990; Schmid 2001). The earliest archaeological evidence for the Nabataean kingdom from their capital city of Petra on the Jordanian plateau dates to the 1st century B.C. ('Amr *et al.* 1998; Graf 1992). This evidence reveals a complex, state level society—one that minted coins, constructed monumental architecture, trained expert hydraulic engineers, and controlled the overland trade of spices and incense from the Arabian Peninsula to the eastern Mediterranean (Schmid 2001).

The traditional model of hinterland settlement patterns under the Nabataean state describes how the flourishing economy of Petra led to the expansion of hinterland agricultural settlements at the end of the 1st century B.C. (Parr 2007; Schmid 2001). This trend continued after the Roman annexation of the Nabataean kingdom in A.D. 106, and it is further attributed to the growing demands of Roman annexation and the kingdoms' increasing wealth from long distance trade (Knodell and Alcock 2011; Kouki 2009; Sartre 2005; Schmid 2001). Near the end of the late Roman period (ca. A.D. 400) agricultural settlement in the Petra hinterlands began to contract as the city's economy declined. A major part of this contraction was a reversion to ruralism in the Petra region and the abandonment of many

B.C./A.D.	Period	Local	Regional
1200			
1100	Iron Age I	Non-sedentary settlement, copper production in Faynan	Formation of local polities (Ammon, Moab, Israel, Judah)
1000			
900	Iron Age IIA/B	Formation of Edomite polity	Continuation of local complex polities
800			
700			
600	Iron Age IIC	Edomite polity becomes tributary state under Assyria	Assyrian imperial expansion
500			
400	Iron Age III	Sparse and small-scale settlement (influence of eastern empires)	Neo-Babylonian and Persian imperialism
300			
200	Hellenistic	Formation of Nabatean kingdom, expansion of agricultural and trade	Seleucids and Ptolemies contest southern Levant
100			
0	Early Roman	Independent Nabatean kingdom, Annexed by Rome in 106 A.D.	Romans and Parthians contest southern Levant
100			
200	Late Roman	Continuity of Nabatean material culture under Roman empire	Romans and Parthians/Sassanians contest southern Levant
300			
400	Byzantine	Decline of trade economy, shift to local agricultural production	Political and economic crisis in Roman Empire
500			
600			

*Compiled from (Bienkowski and van der Steen 2001; Graf 1990; Herr and Najjar 2001; Kouki 2009; LaBianca and Younker 1998; Schmid 2001)

Figure 2 Local and regional southern Levantine chronologies.

small sites (Fiema 2003). At present, our understanding of this process relies on archaeological evidence from Petra and its immediate hinterland, so intensive surveys in the marginal zones can further add to our understanding of the urban-rural relationship during the Roman period.

The landscape of Wadi al-Feidh

Wadi al-Feidh is located approximately 90 km south of the Dead Sea and 120 km north of the Red Sea (FIG. 1). The area is close to the ancient settlements Petra and Khirbat Faynan, whose origins trace back to the Iron Age and earlier (Bienkowski 2011c; Mattingly *et al.* 2007). Wadi al-Feidh flows in a westerly direction from the top of the plateau in the east, which reaches an elevation of 1400 masl, down to the Arabah Valley more than 1000 m below. Altogether, the wadi is approximately 5 km long. The survey zone follows the entire length of the wadi, extending 1 km on either side. This 10 sq km area provided coverage of the wadi's many ecological zones, described below.

As precipitation is strongly influenced by topography, Wadi al-Feidh encompasses a variety of ecological zones ranging from Mediterranean woodland in the east, to semi-arid desert in the west (Cordova 2007). It is also one of a few wadis in the area with a perennial source of potable spring water. This microenvironment provides an above ground source of fresh water that encourages the growth of many plant species, such as almond, Atlantic pistachio, fig, olive, and wild grasses and herbs. The spring also attracts a variety of animal species, including carnivores, ungulates, small mammals, birds, reptiles, amphibians, and freshwater crab.

The eastern half of the survey zone is characterized by Mediterranean and steppe woodland climates, with annual rainfall averages of up to 350 mm (Palmer *et al.* 2007). The geology is composed of beds of yellow and green limestone, green clay, and marl, which make up the yellow Mediterranean soils characteristic of the south Jordanian plateau (Rabb'a 1994). Here the topography alternates between flat terrain and steep slopes, creating a stairway up to the plateau (FIG. 3). Due to these factors, the flat areas were productively farmed throughout antiquity, while the steep slopes were terraced to increase the amount of arable land.

The survey zone follows the steppe westward for about 2.5 km, before reaching its western boundary at the foothills. The foothills are a rugged, mountainous terrain, difficult to navigate, and marked by high, rocky outcrops, steep slopes and cliffs (FIG. 4). Geologically, this area is composed of various types of sandstone beds (Rabb'a 1994). The climate here is semi-arid steppe-desert, with annual rainfall amounts averaging 200 mm (Palmer *et al.* 2007). The amount of arable land decreases in this area, though we still observe agricultural terraces on some of the surrounding hills and in small valleys.

Figure 3 View of steppe landscape. Flat areas have been plowed for agricultural purposes while steeper slopes have been terraced to expand agricultural land. Photo orientation is to the north.

Figure 4 View of the foothills, which are west of the steppe and slightly lower in elevation. The terrain becomes much more jagged and uneven in this area, resulting in many small valleys, steep hills and cliffs. Lush vegetation from the spring microenvironment is visible in the valley bottom. Photo orientation is to the west.

Our survey boundaries end where the foothills make a rapid descent toward the Arabah Valley. Here, the geology changes abruptly to red and purple rhyolite, quartz porphyry, and tuff that comprises the Ahaymir Volcanic Suite (Rabb'a 1994). The paleo-topography of this formation has resulted in jagged relief, making the area impassible except in a few locations. From here, there is a descent of 800 m over approximately 2 km to the lowlands of Wadi Arabah, where Pleistocene and Holocene alluvial fans and aeolian sands continue to accumulate.

Survey Methods

More intensive survey methods developed in other areas of the eastern Mediterranean are often underutilized in the southern Levant, and exceptions (Barker *et al.* 2007; Dark 2008, 2013; Knodell and

Alcock 2011) have not included terrain as severe as the work reported here. While our survey would not be considered a "siteless" survey, that is, a methodological focus on the continuous distribution of surface artifacts (Alcock and Cherry 2004; Caraher *et al.* 2006; Dunnell and Dancey 1983), our methodology was certainly influenced by the work of these intensive survey projects. In addition, the full-coverage methodologies developed in the New World (Fish and Kowalewski 2009; Kowalewski 2008; Sanders *et al.* 1979; Willey 1953) informed a great deal of our survey planning.

We conducted an intensive pedestrian survey of 10 sq km in the steppe and foothills of Wadi al-Feidh. The survey zone was divided into 10 grid squares, each 1 sq km in size. Depending on the density of sites, we spent approximately 4–5 days in each 1 sq km grid square. Our team consisted of 4–5 surveyors who were spaced at approximately 10–25 m intervals. After some experimentation with the space between surveyors, it seemed best not to insist on rigid intervals, but to vary the spacing between us based on common sense concerns such as topography, vegetation, modern occupation, and the complexity of archaeological remains. Sites were recorded on satellite photographs and by an Epoch 10 L1 differential GPS, which allowed for quick and accurate recording of spatial data.

Site boundaries were determined either by artifact fall-off patterns or by the natural geography. In many cases, these coincided. At most sites we encountered low-density artifact scatters, which were not clearly associated with architectural features. Depending on the complexity of cultural remains at a site, we would further subdivide each site into smaller units to maintain better control over the spatial variation of artifacts. Overall, our collection strategy was to carefully document artifacts and physical landscape features separately, as the relationship between the two was not often straightforward. The intensity of coverage was much higher within a collection unit, with surveyors spaced at 5–10 meter intervals, collecting 100% of the artifacts. Small finds included pottery, lithics, glass, and metal. Pottery has been the basis for dating sites, as most of the other materials are not particularly diagnostic.

The definitions of survey intensity—usually measured by the space between surveyors walking transects (Schiffer *et al.* 1978: 13–14)—often vary by region and the goals of the project, the nature of the physical landscape, and other factors. Extremely high-intensity surveys, such as siteless surveys employed in parts of the northern Mediterranean (Bevan and Conolly 2002; Bintliff *et al.* 2002; Caraher *et al.* 2006), place surveyors at 5–10 m intervals. This level of intensity is necessary to document the complexity of continuous artifact distributions in contexts such as plowsoil assemblages (Francovich *et al.* 2000; Schofield 1991). Many Levantine surveys, by comparison, can be characterized as low-intensity, in that they are often vehicular, cover hundreds of square kilometers in one or two field seasons, and seldom focus on off-site areas. Wadi al-Feidh does not have the continuous artifact distributions of plowsoil assemblages, so we did not opt for the close spacing and recording strategy of siteless surveys (Dunnell and Dancey 1983; Gallant 1986). The goal was to strike a balance between the ability to detect small sites while still managing to survey the entire 10 sq km area within the two months allotted. Therefore, our use of the term intensive must be considered within the context of southern Levantine surveys.

We also recorded the presence of terracing on satellite photos of the area. Extensive terracing of the eastern survey region was expected because modern villages have been farming on the steppe for at least the last hundred years. The terraces we observed much farther west, however, where agriculture would have been difficult due to the extreme topography, were more surprising. Due to time constraints we were unable to conduct systematic surface collections from the entirety of the terracing features. Although, our sample of pottery from sites within the terracing features provides a basic foundation for interpreting the duration of agricultural activities, and future fieldwork will address the history of the terraces directly.

Results

In total, we recorded 123 sites ranging in size from 1.2 ha to as small as a few square meters (FIG. 5A). Of these 123, we identified 11 sites dating to the Iron Age and 27 sites dating to the Roman period (TABLE 1). Three of these sites contained ceramics from both periods. Due to the low-density ceramic scatters that dot the landscape, the dates given for many of the sites described below are based on a small number of chronologically identifiable artifacts. We must recognize that many of the features recorded during the survey (i.e., cairns, roads, rock walls, and small structures) may not be contemporaneous with the ceramics that were collected.

Iron Age settlements

During the late Iron Age, two settlement sites were occupied in Wadi al-Feidh: Site 116 and Site 103 (FIG. 5B). We designated these as settlement sites based on the high frequency of surface ceramics, the dense clustering of rooms visible on the surface, and the clear association between the two. Both of

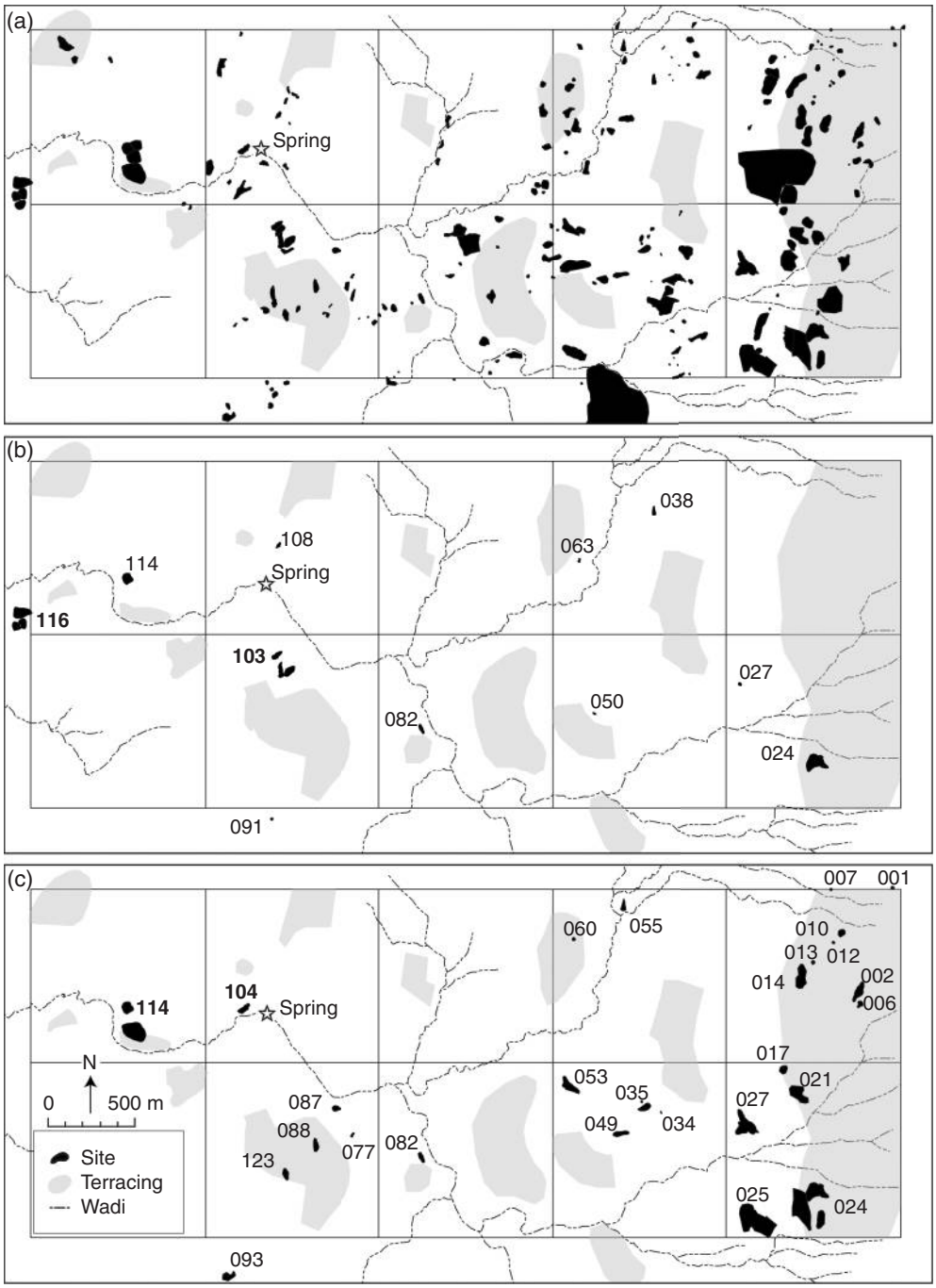

Figure 5 Map showing all recorded sites: A) sites mapped during the Wadi al-Feidh Survey; B) Iron Age; C) Roman period. Sites specifically mentioned in the text are labeled in bold.

these settlement sites appear to have no occupation earlier than the Iron Age, and both were reoccupied later in the Middle Islamic period between A.D. 1000–1400 (Whitcomb 1992). The remainder of the Iron Age sites are composed of artifact scatters and features described above.

The first settlement site, Site 116 (Qurayat Mansur), has been known to archaeologists for some time (Hübner 2004). The site, which is approximately 1.2 ha, was built on a hilltop in the westernmost part of the survey area, on the edge of the foothills described above, and resembles a mesa overlooking the Arabah valley (FIG. 6). Geologically, the site is situated at the eastern boundary of the Ahaymir Volcanic Suite, which is composed of quartz porphyry and granite. This geological formation is characterized by narrow wadis and aggressive relief (Rabb'a 1994: 12). Due to this paleo-topography, when Site 116 was established in the Iron Age, natural cliffs surrounded the site on more than 75% of its circumference. These features restricted access to the site and provided a natural defensibility for the site's inhabitants.

Adjacent to Site 116, Wadi al-Feidh descends westward into the Arabah Valley via a series of 12 waterfalls, some 50–60 m high (FIG. 7). This landscape is impassible without rock climbing gear. Pools of

Table 1 List of Iron Age and Roman period sites recorded during the Wadi al-Feidh survey.

Site	Feature types	Possible functions	Time periods represented*	Area (sq m)
–Iron Age sites–				
024	Mortar, rectilinear/round structures, terraces, wall	Agriculture, processing, temporary shelter	IA, ER, B	8006
027	Round structure	Agriculture, animal penning, temporary shelter	IA, ER, R+	399
038	Cairns	Field clearance, graves, territorial markers	IA	961
050	Cairns	Field clearance, graves, territorial markers	IA	240
063	Rectilinear structure	Animal penning, temporary shelter	IA, IA+	341
082	Campsite, mortars, round structure	Animal penning, processing, temporary shelter	IA, ER, R+, MI+	1095
091	Round structure	Possible cistern, storage	IA, MI-LI	265
103	Petroglyphs, rectilinear structures, walls	Settlement	IA, MI	6387
108	Rock shelter, walls	Animal penning, check dams, storage, temporary shelter	IA	638
114	Rectilinear structure, terraces, walls	Agriculture, animal penning, storage, temporary shelter	IA, ER, R, MI, MI-LI	3122
116	Rectilinear structures, walls	Settlement	IA, MI, MI-LI	9475
–Roman period sites–				
001	Abandoned 20th century rock built house	Unknown, prior remains likely destroyed	ER, R+	261
002	Terracing	Agriculture	R, R+, MI, MI-LI	3504
006	Round structures	Agriculture, storage, temporary shelter	R, R+, MI, MI-LI	823
007	Cairn	Field clearance	ER, R+, MI-LI	129
010	Mortar, rectilinear structure, terracing	Agriculture, processing	ER	1195
012	Cairn	Field clearance	ER	167
013	Cairn	Field clearance	R	302
014	Cairn field	Field clearance	R	5942
017	Cairns	Field clearance	ER	1516
021	Campsite, cairns, walls	Agriculture, animal penning, field clearance, storage, temporary shelter	ER, R+, LR-B, MI-LI	6372
024	Cairns, mortar, rectilinear/ round structures, wall	Agriculture, field clearance, processing	IA, IA+, ER, R+, B, MI	27012
025	Cairns, round structure, wall	Agriculture, animal penning, field clearance	ER, R+, MI, MI+	21694
027	Cairns, round structure	Animal penning, field clearance	IA, ER, R+	9095
034	Cairns	Field clearance, storage, territorial markers	ER	62
035	Campsite, round structures	Animal penning, temporary shelter	R, MI-LI	1958
049	Cairns	Field clearance, processing	R	1792
053	Cairns	Field clearance	ER, R, MI-LI	3855
055	Rectilinear/round structures, walls	Animal penning, check dams, temporary shelter	ER, B+	1102
060	Rectilinear structure	Animal penning, temporary shelter	ER, B	252
077	Rock shelter, round structure	Animal penning, temporary shelter	ER, MI, MI+	257
082	Campsite, mortars, round structure	Animal penning, processing, temporary shelter	IA, ER, R+, MI+	1095
087	Walls	Agriculture, check dams	ER	1044
088	Rectillinear structure	Animal penning, temporary shelter	R, R+, MI-LI	1531
093	Wall	Agriculture, check dam	ER, MI	2289
104	Rectilinear structure, rockshelter	Processing, storage, temporary shelter	ER, R+, B, MI	1774
114	Rectillinear structure, terraces, walls	Agriculture, animal penning, storage, temporary shelter	IA, ER, R, MI, MI-LI	14459
123	Cairns, round structure	Agriculture, animal penning, field clearance, temporary shelter	ER, R, R+	1464

*IA=Iron Age, ER=Early Roman, R=Roman (early-late), LR=Late Roman, B=Byzantine, MI=Middle Islamic (A.D. 1000–1400), LI=Late Islamic (A.D. 1400–1950), + = listed period or later

fresh water, fed by the perennial spring, accumulate below the waterfalls year round. Our survey, which included rappelling, of the area showed that it is possible to access some of these pools from the northern slope of Site 116, which would have provided the inhabitants a protected water source.

Approximately 100 m northeast of Site 116, we recorded terracing in the valley bottom. These

Figure 6 Site 116 (Qurayat Mansur) in the foreground (lower left). The site is constructed on a mesa on the boundary between the foothills and the rugged cliffs above the Arabah Valley, which is visible in the background. Photo orientation is to the west.

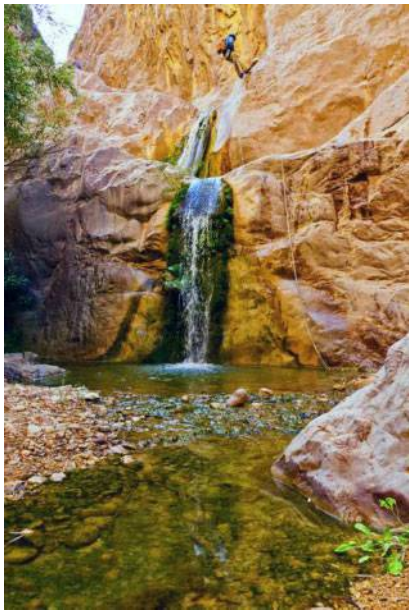

Figure 7 Pools of water accumulate below the waterfalls adjacent to Site 116. These waterfalls are fed by the Wadi al-Feidh spring. Our survey, which included rappelling to explore the waterfalls, demonstrated that these pools are accessible from the north slope of Site 116.

small plots provided land for irrigated agricultural production. In addition, we recorded terracing on many of the hillsides surrounding Site 116. Figure 5B shows the relationship between these terracing features and the Iron Age settlement.

Systematic surface collections at Site 116 showed that late Iron Age ceramics represent a significant majority of the total ceramic assemblage. The late Iron Age assemblage is composed of undecorated coarse-ware vessels for cooking and storage, including various open-form bowls, rilled-rim kraters, and jars (FIG. 8). These utilitarian vessel types are typical of late Iron Age ceramic assemblages from sites throughout southern Jordan (Bienkowski 2011b).

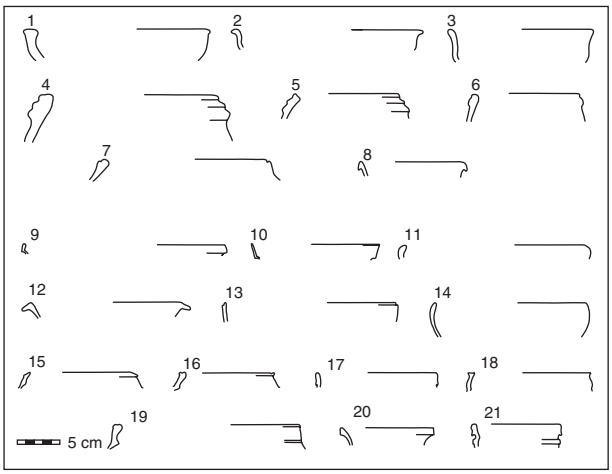

Figure 8 Diagnostic ceramics: 1–3) Iron II bowls; 4–6) Iron II jars; 7) Iron II cooking pot; 8) Iron II jug; 9–14) Early Roman bowls; 15–17) Early-Late Roman jars; 18–19) Late Roman/Early Byzantine transition jars; 20–21) Early-Late Roman jugs.

Architecturally, Site 116 is composed of clusters of rectilinear rooms. Two small clusters are found at the northern and eastern portions of the site, while the largest cluster of rooms is located in the southern part of the site. Much of the site plan follows the natural topography of the hilltop, which is quite uneven in some places. All of the architecture is dry-stone construction using locally available stones. The site's entrance is through a small cluster of rooms in the northeast. Access to the site is limited to this one entrance. A long wall runs along the eastern edge of the site, above a cliff that, to the southeast, is well over 100 m in height; the wall may have served as a windbreak or a retaining wall (Bienkowski 2011a).

The second Iron Age settlement site was recorded as Site 103 (locally known as Khirbat Gleah, after the local toponym for the area). This previously unknown site is located on a high plateau above the spring and measures just under 1 ha. Similarly to Site 116, access to the site is limited by topography. The only entrance is along a winding path from the south. Many small valleys with remnants of ancient terracing surround Site 103.

While most of the ceramics we recovered from Site 103 date to the Middle Islamic period (ca. A.D. 1000–1400), we also found strong evidence for Iron Age II occupation in the northern and eastern portions of the site. The Iron Age ceramic assemblage is composed of cooking and storage vessels, resembling the ceramics found at Site 116.

The architectural features in the northern and eastern areas of Site 103 are distinct from other areas of the site that date to a later occupation phase. Similarly to Site 116, a long wall was built above the cliffs along the site's northern edge. Additional poorly preserved stone structures were recorded in

this part of the site. Architecturally, the structures are distinct from the later-phase rooms, and they may be associated with the Iron Age occupation of Site 103.

At the northwest tip of the settlement we recorded a number of pictographs carved into the exposed bedrock (FIG. 9). The imagery includes animal figures, such as ibex and camels, and human figures. Pictographs are difficult to date with certainty, but many of the motifs have parallels with other ancient southern Levantine sites ranging from the 3rd millennium B.C. to the 7th century A.D. (Eisenberg-Degen and Rosen 2013).

Roman period agricultural processing sites

By the Roman period the major Iron Age settlement sites in the survey area were abandoned. In fact, no Roman settlement sites were recorded within the survey boundaries. Sites 104 and 114, however, have evidence of Roman period agricultural production (FIG. 5C). Other than this, the majority of Roman period sites we recorded are composed of artifact scatters and off-site features.

Site 104 is located adjacent to the perennial spring in the valley bottom. Fig, oleander, and tamarisk are abundant around the spring and may have been in antiquity as well. The processing site is small, less than a quarter hectare, and while the remaining architecture is badly disturbed, we observed many ground stones (including one milling stone) on the surface. The ceramic assemblage is composed of a variety of undecorated coarse- and fine-ware vessels, including plain Nabataean fine-ware bowls, plain jars and jugs, and cooking pots (FIG. 8). These ceramics date to the late 1st through late 2nd century A.D. Based on these artifacts and the small size of the site, it seems likely that the site was used for processing agricultural crops.

Perhaps the most interesting features of the site are two rock-cut canals that begin immediately to the west of Site 104 (FIG. 10). These canals are cut into the sandstone 1–2 m above the current streambed. They are approximately 20 cm wide by 20–30 cm deep and are quite regular in their construction. The canals continue along the valley for approximately 1 km and end at Site 114, where we also found evidence of early Roman ceramics.

Site 114 (also known as Khirbat Feidh) was surveyed unsystematically in the past (Hübner 2004). Based on our systematic surface collections, the Roman period is most abundantly represented here. The architectural features of the site are badly preserved, making it difficult to say more about the spatial organization or the function of the site. A number of wall lines are visible on the surface, and the valley bottom adjacent to the site contains the remains of terrace walls, suggesting that this may be an agricultural installation.

Non-settlement sites

The remainder of the Iron Age and Roman period sites consists of what we describe as non-settlement sites. This category includes features such as small structures, cairns, walls and terraces, campsites, rock shelters, and bedrock mortars (TABLE 1). Determining the function of these features is difficult, but often such places reflect functions related to agriculture and pastoralism, such as short lived settlements (as in the case of campsites and rock shelters), penning for animals, tool storage, and structures for trapping water and soil. While these features are often physically associated with the small finds we collected, it was often difficult to determine whether

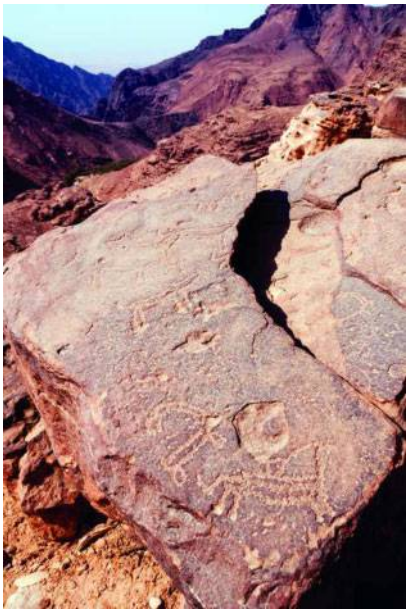

Figure 9 Petroglyphs from Site 103 on the bedrock outcrop at the north point of the site, overlooking the valley bottom and the spring.

Figure 10 One of the rock-cut canals connecting Site 104 and 114. These canals are typical of Nabataean hydraulic engineering and are cut directly into the sandstone bedrock a few meters above the valley bottom. For reference, the author is standing in the canal.

they are chronologically associated. Many of the features appeared rather old, due to the presence of lichen, the accumulation of sediment around them, and their collapse and deterioration. The passage of time indicated by these observations is impossible to infer at this time.

We recorded nine non-settlement sites with Iron Age ceramics (FIG. 5B). Spatially, these Iron Age sites are spread throughout the entire survey area, and are small compared to the size of Roman period non-settlement sites. In most cases, they are also located in close proximity to the terraces we recorded during the survey. The features most commonly recorded at these sites were small structures and cairns, but we also identified bedrock mortars, campsites and rock shelters, and isolated walls and terraces. These ephemeral structures are a common landscape feature in southern Jordan and often reflect the use of the terrain by agro-pastoralists.

Roman period non-settlement sites were far more numerous in the survey; we recorded 27 with Roman period ceramics (FIG. 5C). These sites tend to be concentrated in the eastern half of the survey area, where the land is better for agricultural production, and their size increased in comparison with earlier Iron Age sites. Overall, the sites are also found in close proximity to terraces, especially those recorded within the steppe landscape described above. Small structures and cairns were the most commonly recorded features at these sites, in addition to a small number of bedrock mortars, campsites and rock shelters, and isolated walls and terraces.

Small round and rectilinear structures were the most common features associated with both Iron Age and Roman period sites. These features are no more than a few courses in height, and range in size from 2 m in diameter to as large as 8×15 m. Most appear to have been unroofed, serving as some type of enclosure. In some cases, they are associated with isolated walls or terracing. These features are found throughout the survey area, but are most concentrated in the eastern region, on the steppe, where site densities are highest overall. Though it is difficult to identify their function specifically, these features may have been used as animal enclosures, temporary shelter, for processing crops, or for storing agricultural supplies and products.

The second most common features recorded during the survey were cairns. Cairns are here defined as large piles of rocks ranging in size from 1–5 m in diameter with some reaching as high as 2 m. As is the case with the small structures, cairns were concentrated in the steppe zone of the eastern survey area, where they likely represent the clearing of rocks from agricultural fields, many of which show signs of recent plowing. Though some of the cairn sites we recorded appeared to be fairly recent, others appear to be heavily lichen coated and very eroded, perhaps hinting at a much older age. The ceramic assemblages associated with some of the cairn features hint at possible Iron Age origins. Throughout antiquity cairns have served a variety of purposes that are hard to identify without excavation. Some of the cairns we recorded were clearly related to the clearance of agricultural fields, while others served less obvious purposes. At Sites 38 and 50 we were able to identify the function of the cairns as graves. These features had been looted, leaving the interior of the cairn exposed and some of its contents scattered nearby. We observed an interior cist that had been exposed by the looting, and human remains around the cairn.

Roads and trails were also a common feature in the landscape. Modern Bedouin goat herders use many of these roads, although their antiquity is evident from the ancient sites they connect. The dating of roads is difficult, and not something we attempted for this project. However, other projects have been successful in mapping Iron Age and Roman period roads and trails from nearby regions from archaeological and historical data (Kloner and Ben-David 2003; Roll 2007; Smith et al. 1997). One of the major roads we explored begins near Site 114 and runs westward over the mountains and down into the Arabah Valley. Due to the extreme topography of the foothills mentioned previously, this is a unique feature in southern Jordan, and only a small number of routes connecting the Arabah Valley with the Jordanian plateau are known to have been used during antiquity (Ben-Yosef *et al.* in press).

Discussion

The results above demonstrate the ability of intensive, systematic survey to recover a significant amount of data from even the most environmentally marginal areas. The small and ephemeral sites we recorded are unlikely to be discovered using extensive surveying methods, which have traditionally spaced surveyors at much wider transect intervals or were conducted from a vehicle. Such survey methods are often employed to record large, agricultural settlements, with little or no focus on the small sites and features that are typical of non-sedentary groups. Systematic survey of marginal regions such as Wadi al-Feidh are also important for recovering data on agro-pastoralism and other forms of semi-sedentary lifestyles because these areas are frequently inhabited for this purpose. Limited agricultural productivity, difficult terrain, and semi-arid conditions placed a number of restrictions on the settlement patterns we observed through time, and over the span of a millennium these patterns changed dramatically in relation to broader regional-scale phenomena.

This data provides the foundation for a more thorough and complex understanding of settlement systems from two of the peak periods of cultural development in the southern Levant—the Iron Age and Roman periods.

The Iron Age settlement pattern and social organization

Survey of Wadi al-Feidh has generated new lines of evidence for understanding late Iron Age settlement patterns. Whereas settlements on the plateau were structured around a loosely organized agricultural state, the settlements below (i.e., west of) the plateau do not share this practice. The results from Sites 116 and 103 are rather more suggestive of the practice of a mixed subsistence economy, and the limited amount of arable land surrounding these sites suggests that agricultural production was not a major focus of subsistence. Land for small-scale farming, grazing, as well as wild plant and animal resources around the perennial spring, on the other hand, are all within close proximity to these sites. Given these factors, it is unlikely that Iron Age communities living in Wadi al-Feidh procured their subsistence from agricultural production alone. Instead, the locations of these small settlements in areas that provided access to multiple resources may reflect a subsistence strategy of resource diversification and mixed agro-pastoralism, a common practice amongst groups inhabiting environmentally marginal areas (Marston 2011; Spielmann *et al.* 2011).

While we do not have any excavation data from these 8th century B.C. settlements in Edom to present a detailed reconstruction of their subsistence strategies, published excavations from early Iron Age (ca. 1200–1000 B.C.) settlements on the central Jordanian plateau are an excellent analogy. The excavators of Khirbat al-Mudayna al-Aliya (KMA) carried out a detailed study of the palaeobotanical and archaeozoological remains of the settlements. As expected, domesticated grains and livestock were abundant. But in addition to these staples, a significant amount of wild resources, such as wild grasses and wetland weed species, were recovered alongside domesticated barley. The excavators suggest that cultivated crops were planted near the water source, rather than near the settlement (Lev-Tov *et al.* 2011). In mountainous or broken landscapes it is common for farmers to travel long distances to reach their crops (Forbes 2007: 190–195), so this should not come as a surprise. Furthermore, this could be an indication that wild plants were gathered alongside domesticated crops. In the case of Wadi al-Feidh, Iron Age communities would have travelled a few hundred meters to as much as a few kilometers to reach the closest agricultural terraces mapped by our survey.

The archaeozoological remains from KMA further suggest that—in addition to domestic cattle, goat, pig, and sheep—wild animals were also exploited (Lev-Tov *et al.* 2011). Among the faunal remains collected at the settlement were red deer, small and large bird species, small fish, and freshwater crab—all species also available around Wadi al-Feidh. Local communities may have obtained these resources through hunting and/or gathering. In any case, the data demonstrate the diversity of subsistence practices in place at KMA, and the extent to which the ancient inhabitants of the site took advantage of the local environment to procure their food.

The two Iron Age settlements in Wadi al-Feidh were built at locations with easy access to the spring microenvironment, where fresh water, wild resources, and agricultural land were readily available. The off-site data further imply that Iron Age groups built terraces and other water management features for water and soil retention. These features need not have been solely for the production of food for human consumption, as animal fodder may have also been an important agricultural crop (Forbes 1998; Palmer 1998).

While we are unable to identify the exact function of each of the off-site features we recorded, taken as a whole, they appear to reflect the use of the landscape for activities such as agricultural production and animal grazing. Numerous small structures, terraces and other walls, cairns and other features are commonly associated with the practice of mixed agro-pastoralism, including check dams (small dams and retaining walls) for soil and water retention, small plots of land for growing food or animal fodder, temporary shelter, animal penning, and food and tool storage. Altogether, the results suggest that ancient communities took advantage of the many subsistence options available to them, and practiced a strategy of low-intensity agriculture, combined with the utilization of locally available resources. This is a common risk-buffering technique often observed for small-scale societies (Butzer 1996; Marston 2011; Zori and Brant 2012).

Site 116 has been compared to other hilltop sites known throughout Edom. These sites are seen as places of refuge, as their locations are easily defensible, and sometimes even seem secretive (Lindner and Farajat 1987; Lindner *et al.* 1996b). Such sites, the argument goes, would have been occupied temporarily during times of political turmoil—perhaps during skirmishes with neighboring polities such as Moab or Judah, or with an Assyrian army collecting tribute. This hypothesis is problematic. Despite their defensible characteristics, Sites 116 and 103, along with many of the other hilltop settlements, were much more than temporary refuges. As the data

from Wadi al-Feidh suggests, the labor invested in construction, and the density of surface ceramics, point to at least a semi-regular occupation. Systematic survey of the settlement and off-site features leads to a very different interpretation of how these two Iron Age settlements functioned. Microenvironments like the one provided by Wadi al-Feidh spring are not a common landscape feature in southern Jordan. Extensive areas for pasturing, small plots of arable land, perennial water, and wild resources were readily available within a distance of a kilometer or less. In this light, we argue that the ancient Iron Age communities of Wadi al-Feidh practiced small-scale agro-pastoralism and exploited the unique ecological resources provided by the landscape. This environmental diversity was neither available, nor necessary, to the large agricultural villages on the plateau, but was essential for the survival of the inhabitants of Wadi al-Feidh.

The Roman period settlement pattern and social organization

During the Roman period, the traditional model of hinterland settlement pattern expansion is supported by our results. The data we collected in Wadi al-Feidh support the idea of an expansion of agriculture, with a peak near the beginning of the late Roman period (the end of the 1st century A.D.). The survey data suggest that Wadi al-Feidh was exploited primarily for agricultural production and animal grazing, as no settlement sites were recorded in the survey boundaries and most of the artifact scatters and features were recorded in close proximity to agricultural terraces. A vast majority of the Roman period ceramics were collected in the eastern half of the survey area, in the Mediterranean and Steppe climate zones, which would have been the most productive for expanding agricultural activities.

Nabataean agricultural production is well attested throughout southern Jordan. Recent excavations and dating of terraces near Petra confirm their Nabataean origin (Beckers *et al.* 2013). Common crops produced by the Nabataeans included domesticated grapes, olives, and wheat and barley. In addition, they cultivated local plants used in the production of unguents, such as rock rose, terebinth, and balanos (Johnson 1987). While our results are consistent with existing models of agricultural production, they add to our understanding of the significant investments the Nabataeans made in the agricultural hinterlands. For instance, evidence of agriculture is usually found in valleys higher up on the plateau, therefore finding it in marginal zones such as the western half of Wadi al-Feidh is unusual. Thus, the terracing of many high relief areas deeper into Wadi al-Feidh, along with the evidence of processing that went on there, suggests a substantial investment in the construction, maintenance, and labor output in this area.

As the survey results demonstrate, Roman period agricultural production extended farther down the valley at processing sites 104 and 114. Abundant ground stone artifacts and a single milling stone recovered from Site 104 suggest that this site was used by the Nabateans for processing agricultural crops. This processing may have required a source of water, which was in abundance here due to the proximity to the spring.

Interesting features of Site 104 are the rock-cut canals, which follow the length of the wadi until they reach Site 114. Such features are typical of Nabataean hydraulic engineering, the most famous examples of which are found throughout the ancient city Petra. The Site 104 canals, which were hand carved into the bedrock for a length of approximately 1 km, imply that Sites 104 and 114 were related in their functions. Furthermore, the canals reflect the substantial labor investment made by the Nabataeans at the two processing sites. Unfortunately, the sites are poorly preserved, so any interpretation beyond this basic characterization is impossible.

Although no Roman period settlements were recorded in the valley itself, villas and farmsteads have been recorded from regions nearby. For example, in the nearby area of Jabal as-Sufaha, Lindner and colleagues (1998) reported settlement sites dating to the early and late Roman period. Based on the results of our survey and other surveys from this region, the settlements on Jabal as-Sufaha were probably related to the management of agricultural exploitation in Wadi al-Feidh by wealthy sub-elite members of Nabataean society. The extension of this system into Wadi al-Feidh reflects the effort to which ancient cities, such as Petra, went to exploit their agricultural hinterland.

Conclusions

The research design for the Wadi al-Feidh survey was aimed at providing a detailed examination of the marginal environmental zone that connects the Mediterranean highland plateau and lowland desert zone of southern Jordan's Edom region. The research is particularly unique for the region because it targeted a valley in an ecologically marginal location with rough topography. We have shown that intensive and systematic survey is a feasible survey method in this rough environment, and this method made it possible for us to detect very local-scale and ephemeral activities that have often eluded traditional survey work in the southern Levant. These activities included small-scale agro-pastoralism, extensive farming and cultivation, and animal grazing.

More specifically, we have found that late Iron Age communities in Wadi al-Feidh took advantage of local microenvironments to practice small-scale agro-pastoralism. The perennial spring, in particular, must have played a key role in the choice of settlement location for these groups. Although settlement sites such as 116 and 103 have been interpreted as hilltop refuges, through our survey we have shown that the locally available resources could have supported the probable semi-permanent occupation at those sites. Indeed, the survey results suggest a more permanent occupation and use of local landscape resources than has been previously recognized. The locations of these settlements provided ancient communities with easy access to agricultural and pasture land, as well as wild plant and animal resources.

We have also shown that by the Roman period these settlements were abandoned. The survey results suggest that agricultural production, and perhaps animal husbandry, was the primary reason for the exploitation of Wadi al-Feidh during this time. Expanding agricultural production under the Nabataean kingdom targeted the Mediterranean and steppe woodland climate zones most heavily, as these were the areas with the most agricultural potential. While agricultural production is well attested during this time in other regions, the presence of terraces in the deeply incised portions of Wadi al-Feidh suggest much more investment in agriculture than previously recognized, and perhaps reflects the western extent of agricultural production on the plateau. The wadi also appears to have been used for the processing of crops, as attested at processing sites 104 and 114. Furthermore, rock-cut canals are a characteristic feature of Nabataean hydraulic engineering, and they attest to the amount of labor invested in resource extraction. From the perspective of the rural hinterland, the Nabataean kingdom had little trouble extending its influence into this marginal zone.

Rugged terrain is often avoided or given less attention due to the costs associated with conducting a survey project there. Pastoral landscapes and traces of small-scale agricultural production, however, will often be transformed or erased by large-scale cultivation. Difficult to reach places were often home to groups who sought to maintain an alternative lifestyle, and because of this are among the few places where archaeologists can get a clear picture of aspects of the local economy, such as subsistence practices and land use. While many questions remain, we believe our preliminary systematic survey results offer important insights for a diachronic study of subsistence economies and social organization. Though the survey was focused on a 10 sq km region, our ability to interpret the results was aided by existing large-scale regional surveys. Thus, our project also demonstrates the importance of a multi-scalar approach to surveying, echoed in many recent survey publications (Honeychurch *et al.* 2007; Ur and Hammer 2009). For archaeology in the southern Levant to move beyond the study of cities and tells to include a more robust understanding of alternative forms of settlement, we must extend our research into less hospitable locations.

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Kyle A. Knabb (M.A. 2010, University of California, San Diego) is a Ph.D. candidate in the Department of Anthropology at the University of California, San Diego. His dissertation examines settlement patterns and environmental degradation in the marginal environments of southern Jordan.

Thomas E. Levy (Ph.D. 1981, University of Sheffield) is Distinguished Professor in the Department of Anthropology at the University of California, San Diego. He directs the Levantine and Cyber-Archaeology Laboratory at the University of California, San Diego.

Mohammad Najjar (Ph.D. 1981, Academy of Sciences, USSR) is a researcher in the Levantine and Cyber-Archaeology Laboratory, University of California, San Diego and Academic and Curatorial Advisor at the Museum with No Frontiers, Jordan. His research interests focus on Levantine Archaeology and world cultural heritage development.

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